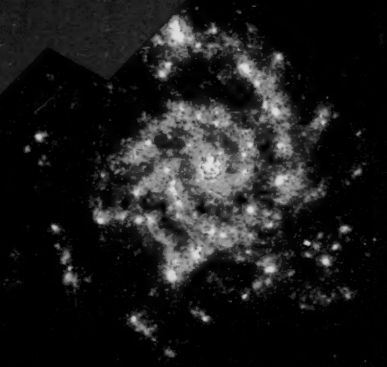
Scientific and Technical Aerospace Reports



An Abstract Journal

NASA PROGRAM SCIENTIFIC & TECHNICAL INFORMATION

Volume 31, Number 5
May 1993
N93-15659 to N93-17808

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Scientific and Technical Aerospace Reports

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Front Matter
A typical citation and abstract sample explaining the standard format, which includes codes for ordering reports.

An Abstract Section
Citations and abstracts of reports and publications that provide comprehensive coverage of worldwide aerospace-related topics including aeronautics and space science technology. *STAR* lists published and publicly available reports entered into the NASA STI Database during the four weeks preceding publication of this issue. These citations and abstracts are listed by subject categories.

An Index Section
- Subject
- Personal author
- Corporate source
- Contract number
- Report number.

Appendix
A guide for ordering cited reports, registering with the NASA STI Program, and using the available products and services. Additionally, price schedules, phone numbers, and addresses are included in this information packed section.

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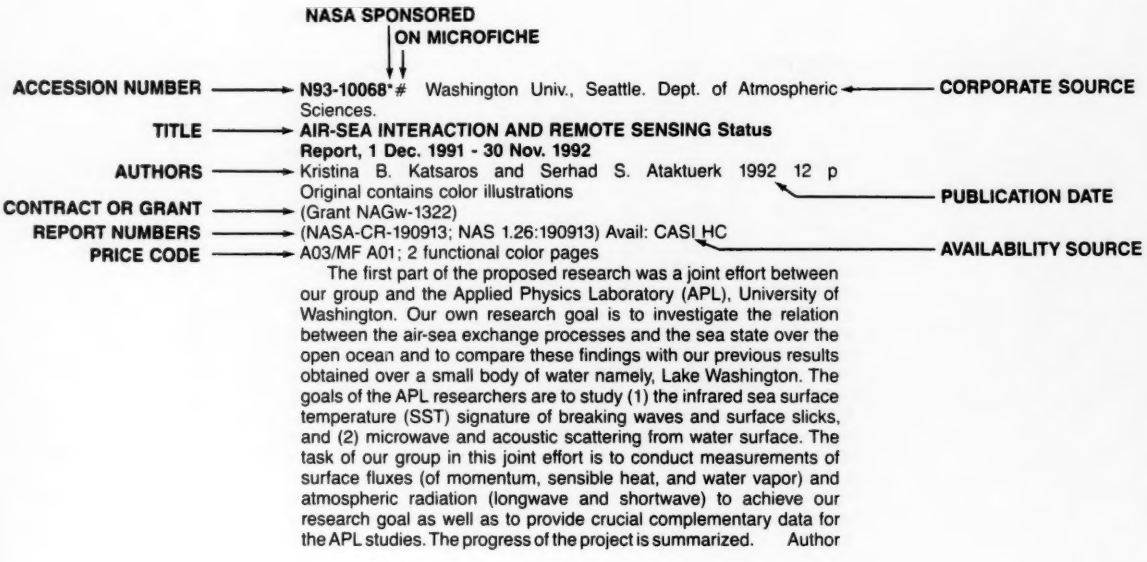

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Scientific and Technical Aerospace Reports

A Monthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N93-15946# National Aerospace Lab., Tokyo (Japan).
SPECIAL PUBLICATION OF NATIONAL AEROSPACE LABORATORY
Sep. 1991 97 p
(DE93-716176; SP-15) Avail: CASI HC A05/MF A02

The lectures are classified by theme into the following: receptivity and instability; three-dimensional boundary-layer transition; development of vortexes and turbulence structure; transition and control of turbulence; etc. In the study on receptivity and instability, analyses using nonlinear amplitude equations are made on receptivity of boundary layers, especially numerical simulations of conditions under which disturbances excite T-S waves and interference of N-number unstable modes. In the study of transition of three dimensional boundary layers, the experiment was conducted to elucidate the turbulence transition process of a swept wing and a swept cylinder. In the study on the development of vortexes and turbulence structure, reported is the experiment on response to the sound of the high shear layer which is formed by exciting longitudinal vortex pair using blowout from the wall slit. In the study on transition and control of turbulence, made are investigations on the effect of triangle riblets on turbulent flow transition of boundary layers and the numerical simulation by the spectral method on convective secondary flows generated in the flow in the rectangular duct of which the bottom and the side walls are heated. DOE

N93-15949# National Aerospace Lab., Tokyo (Japan).
SPECIAL PUBLICATION OF NATIONAL AEROSPACE LABORATORY
Dec. 1991 354 p
(DE93-716195; SP-16) Avail: CASI HC A16/MF A03

This is the proceedings of the 9th symposium on aircraft computational aerodynamics held during 12-14 June 1991 at National Aerospace Laboratory. At the symposium, 53 studies were reported, and a number of advanced computational methods to challenge the most up-to-date problems in fluid dynamics were developed. The following technologies were discussed: modeling of complicated flows in the contest of space engineering; high-speed computation technology, mainly the development of simulation methods; technology supporting wind tunnel tests; and developments in making image processing technology applicable. DOE

N93-16465# Manchester Univ. (England). Aeronautical Engineering Group.
THE GOLDSTEIN AERONAUTICAL ENGINEERING RESEARCH LABORATORY
1991 59 p
(Aero-Rept-9109; ETN-92-92777) Avail: CASI HC A04/MF A01

The Goldstein Laboratory (England) houses one of the largest university based aerodynamic facilities in Europe. It is also the operational headquarters of a company conducting research and testing in all areas of fluid mechanics and aerodynamics. The following are addressed: the director and former directors of the laboratory; laboratory and computer resources; location of the Goldstein Laboratory; history of the laboratory and the school of aeronautical engineering; laboratory layout; experimental facilities. ESA

N93-17666# Naval Postgraduate School, Monterey, CA.
A DATABASE APPROACH TO AIRCRAFT CARRIER AIRPLAN PRODUCTION M.S. Thesis
Robert M. Stammer Sep. 1992 76 p
(AD-A257737) Avail: CASI HC A05/MF A01

This thesis addresses a known problem in carrier aviation: the constant duplication of effort in writing the carrier airplan. This problem is common to all airwings and results in late airplan publish times which reduce the combat effectiveness of the battlegroup. The analysis of the airplan is accomplished through the establishment of a database of carrier airplans. The database interacts with a spreadsheet designed to help strike operations aboard the carrier streamline the process of writing the airplan. The prototype model developed accepts inputs from the Assistant Strike Operations Officer. The model searches the database for airplans that conform to his inputs and provides candidate airplans for review. Once an airplan is selected, an airplan template, in spreadsheet format, can be altered to meet any required changes. Once changed to meet specific tasking the final product can be saved. After a period of operations, the database search file can be updated to mold the database to a specific ship and airwing's standard operating routine. GRA

N93-17732# Federal Aviation Administration, Atlantic City, NJ.
PROCEEDINGS OF THE AIAA/FAA JOINT SYMPOSIUM ON GENERAL AVIATION SYSTEMS
Gus Ferrara and Karen Mason Jun. 1992 516 p Proceedings held in Wichita, KS, 16-17 Mar. 1992
(AD-A257780; DOT/FAA/CT-92/17) Avail: CASI HC A22/MF A04

The 1992 AIAA/FAA Joint Symposium on General Aviation Systems was the result of the combined efforts of the AIAA General Aviation Systems Technical Committee and the Federal Aviation Administration Technical Center. This symposium offered the opportunity to present and review the current state of the art in research that is being conducted in support of general aviation. All told, the papers presented covered the entire spectrum of research, and the participants had the opportunity to hear presentations on everything from alternate fuels to developments in air traffic control. GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N93-15889# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.
TRANSITION INDUCED NORMAL FORCES AND THEIR EFFECTS ON THE AERODYNAMIC CHARACTERISTICS OF SLENDER SHARP CONES
Lou Hongtian 5 Mar. 1992 34 p Transl. into ENGLISH from Yuhang Xuebao (China), no. 3, 1989 p 54-64
(AD-A256802; FASTC-ID(RS)T-0790-91) Avail: CASI HC A03/MF A01

When there is boundary layers transition, whether or not one has the appearance of induced normal aerodynamic loads is a very significant question. This article introduces static and dynamic aerodynamic force experiments which were completed in hypersonic wind tunnels. They experimentally verify the existence of this type of load in normal directions. It is created by the asymmetrical nature of boundary layer transitions. In conjunction with this, they have clear and regular influences on the aerodynamic characteristics of long slender cones. GRA

N93-15920# Naval Postgraduate School, Monterey, CA.
COMPUTATIONAL INVESTIGATIONS OF A NACA 0012 AIRFOIL IN

LOW REYNOLDS NUMBER FLOWS M.S. Thesis
Lisa M. Nowak Sep. 1992 147 p
(AD-A257300) Avail: CASI HC A07/MF A02

A steady flow analysis is conducted for a NACA 0012 airfoil in low Reynolds number flows ranging from 540,000 to 1,000,000. Emphasis is placed on prediction and location of the separation bubble. Computational methods include the direct boundary layer method, the viscous-inviscid interaction method, and the time-averaged Navier-Stokes method. Characteristic trends in skin friction coefficient, displacement thickness, and boundary layer velocity profiles with increasing angle of attack are observed. Computational results are compared to each other and to experimental photographs visualizing the density flowfield using Point Diffraction Interferometry. Both the viscous-inviscid method and the Navier-Stokes method failed to accurately represent leading edge separation bubbles. The direct boundary layer method, usually considered of very limited usefulness due to a singularity in the underlying equations at separation, is shown to exhibit unexpected recovery behavior for small amounts of separation. Furthermore, the results near the leading edge, where separation bubbles were computed, were validated by the experiment. GRA

N93-16157# Naval Postgraduate School, Monterey, CA.
QUANTITATIVE-FORCE MEASUREMENTS OF PNEUMATIC CONTROL ON A WING/STRAKE MODEL M.S. Thesis
James G. Willson Sep. 1992 119 p
(AD-A257343) Avail: CASI HC A06/MF A02

A low speed wind tunnel study to quantitatively measure the lift and drag effects of pneumatically controlling a leading edge vortex generated by a half-span, generic fighter wing model was conducted. The study measured the added lift and drag upon the model, throughout a range of angles of attack, utilizing blowing tubes of different geometry and orientations. The effects of blowing upon the high pressure side of the strake were also investigated. Results showed that the effects of blowing were limited to changes in lift with no apparent changes in drag. Blowing appeared to reattach the flow during the initial stages of wing stall. Blowing increased lift by a maximum of 3.75 pct. at angles of attack greater than 25 degs. The effects of blowing appeared oscillatory with respect to angle of attack. Blowing rates were varied from Cmu = 0.0 to 0.0035 in an attempt to determine an optimum. It was found that changes in blowing rates had little effect upon delta CL. GRA

N93-16210# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
EXPERIMENTAL AND NUMERICAL INVESTIGATION OF VORTEX FLOW OVER A 76/60-DEG DOUBLE-DELTA WING
J. E. J. Maseland and N. G. Verhaggen Apr. 1992 99 p
(LR-680; ETN-92-92875) Avail: CASI HC A05/MF A02

A low speed wind tunnel investigation of the characteristics of the vortex flow over a 76/60 deg double delta wing at a constant angle of attack of 20 deg is described. The objective of the investigation was to support the development and validation of numerical codes by generating experimental data in the vortex interaction downstream of the strake-wing leading edge kink of a double delta wing. Detailed flow field surveys and surface pressure measurements provide data on the pressure and velocity distribution at various chordwide stations. The experimental data is compared with numerical solutions of a free vortex sheet and a Navier-Stokes code. ESA

N93-16467# Manchester Univ. (England). Aeronautical Engineering Group.
HYPERSONIC FLOWS INCLUDING REAL GAS EFFECTS Ph.D. Thesis
S. Shahpar and I. M. Hall 1991 612 p
(Aero-Rept-9112; ETN-92-92778) Avail: CASI HC A99/MF A06

The development of an overlapping grid technique to allow mesh configurations to be designed for local elements of a complicated three dimensional shape, the addition of a global iteration procedure for solutions of the Parabolized Navier-Stokes (PNS) equations, and the use of TVD schemes to solve flows at high temperatures where real gas effets are important are reported. Both equilibrium and nonequilibrium flows are considered. Overlapping grids were used on two specific problems which model particular aspects of a reentry vehicle: for the inviscid, hypersonic, perfect gas flow over a double ellipse, modeling a forebody canopy junction, and for a similar flow over a highly swept cylinder emerging from a flat plate, similar to the wing root junction of Hermes. An efficient implicit noninteractive PNS code was developed and validated through a simple test case. However, a single pass PNS code is only suitable where the viscous inviscid interaction is weak. The use of a global interation procedure for solving strong interaction problems was demonstrated for a family of compression corners in hypersonic flow. Using an equilibrium air model some hypersonic blunt body flows are computed and the results were consistent with similar ones obtained by other authors. Nonequilibrium flows introduce stiffness problems which were dealt with by designing a point implicit TVD method. The algorithm was successfully applied to configurations which are shortly to be tested in a shock tunnel. Validation of the latter code will be made as soon as the experimental results are available. ESA

N93-16470# Manchester Univ. (England). Aeronautical Engineering Group.
COMPUTATIONAL STUDY OF REAL GAS EFFECTS IN HIGH SPEED HIGH TEMPERATURE FLOW, VOLUME 2 Final Report, 1991
S. Shahpar, I. M. Hall, and D. I. A. Poll 1992 112 p
(Contract SMD097865)
(Aero-Rept-9203-Vol-2; ETN-92-92780) Avail: CASI HC A06/MF A02

The computational results and the development of programs on real gas effects are presented. Nonequilibrium chemically reacting inviscid flow programs are described for high enthalpy shock tunnels as well as high speed atmospheric reentry flows. Initially the programs were intended to be research codes; they were made as user friendly as possible. The high speed chemical nonequilibrium calculations were performed using the computer codes CYLO2 and CYLAIR. The computations were made on a VP-1100 computer. The computational results show that the present total variation diminishing scheme is satisfactory for simulation of low hypersonic flows with real gas effects. There is an uncertainty of about 8 percent on the stagnation temperature for free stream Mach numbers of the order of 20 when compared with published results. In the light of the obtained results, more work to understand the effects of real gas nonequilibrium chemistry is recommended. ESA

N93-16508 California Inst. of Tech., Pasadena.
MIXING AND REACTION IN THE SUBSONIC 2-D TURBULENT FREE SHEAR LAYER Ph.D. Thesis
Clifford Eugene Frieler 1992 259 p
Avail: Univ. Microfilms Order No. DA9232175

The amount of mixed fluid is estimated by performing 'flip' experiments and sensing the heat released due to reactions between H2, F2 and NO carried in inert diluent gases. The effects of density ratio, chemical kinetics and Reynolds number were investigated using this approach which avoids the usual resolution limitations. Experiments covering a factor of 30 range in density ratio are presented. Several aspects of the mixing process, such as the distribution of mixed fluid, appear insensitive to density ratio. The integral amount of mixed fluid varies less than 6 percent. This insensitivity contrasts with that of the profiles of mixed fluid composition. While having similar shapes, the composition profile offset depends strongly upon the density ratio. Power spectral densities of the temperature fluctuations are presented and are found to collapse upon normalization with the adiabatic flame temperature and large-structure passage frequency. Probability density functions of composition are presented and indicate that for all density ratios, a predominant composition of the mixed fluid exists within the turbulence. The initial work of Mungal and Frieler on the effects of chemical kinetics on the formation of product in the 2-D mixing layer has been greatly expanded. Measurements have been extended to include a wider range of NO concentrations and have been performed for two other stoichiometries. Results indicate that the simple model used to explain the effects of reaction kinetics in Mungal and Frieler may only be suited for cases with extreme stoichiometry (very high or very low). It has also been found that more product is formed when F2 is the rich reactant than when H2 is the rich reactant. This dependence upon molecular character questions both the experimental technique and theory and modeling of this reacting flow, and stems from a coupling of the effects of differing diffusivity and chemical kinetics. Numerical calculations based on simplified flow models are reported that demonstrate this coupling. The effects of Reynolds number are also examined. Evidence of the remnants of the initial roll-up and mixing transition is seen for Reynolds number as large as 30,000. Resonance

with the acoustic mode of the apparatus affects results for Reynolds numbers up to 60,000. Natural transition of the high and low-speed boundary layer at the mixing-layer inlet affect the high Reynolds number data. In spite of these qualifications, the amount of mixed fluid is nearly constant. Over the range of Reynolds numbers 10,000 to 200,000 it varies by less than 12 percent and displays no asymptotic decline. Dissert. Abstr.

N93-16522 ESDU International Ltd., London (England).
MAXIMUM LIFT OF WINGS WITH LEADING-EDGE DEVICES AND TRAILING-EDGE FLAPS DEPLOYED
Nov. 1992 24 p
(ESDU-92031; ISBN-0-85679-837-1) Avail: ESDU

ESDU 92031 provides an empirical method for straight-tapered wings with leading-edge devices deployed, with or without the deployment of trailing-edge flaps, at freestream Mach numbers up to 0.25. The maximum lift of the wing with high-lift devices retracted is first calculated (by the method of ESDU 89034 which uses predictions for the maximum lift of the aerofoil from ESDU 84026). ESDU 92031 then predicts the increment in maximum lift due to deploying a leading-edge device by applying the increment in two-dimensional flow obtained from ESDU 85033 to the most highly-loaded section with allowances for the effects of wing aspect ratio, taper and sweep, and for the effects of part-span (the device must extend to the wing tip) if appropriate. In the absence of a deployed leading edge device, the deployment of a trailing-edge flap yields an increment in maximum lift, obtained from ESDU 91014, which is reduced due to mutual interference when the devices are deployed together by a decrement obtained from ESDU 92031. The method applies for wing aspect ratios of 3 to 9 and leading-edge sweeps up to 50 degrees with plain, split, or single- or multiple-slotted trailing edge flaps, and leading-edge flaps, slats, or vented or unvented Kruger flaps. It predicts the increment in maximum lift coefficient due to leading-edge devices, alone or in combination with trailing-edge flaps, to within 0.1. A similar accuracy applies for the overall maximum lift coefficient of the wing with deployed high lift devices. Two worked examples illustrate the use of the method. ESDU

N93-16538*# Eloret Corp., Sunnyvale, CA.
PARTICLE KINETIC SIMULATION OF HIGH ALTITUDE HYPERVELOCITY FLIGHT Progress Report, 1 Feb. - 31 Dec. 1992
Klaus Heinemann, Iain D. Boyd, and Brian L. Haas 4 Jan. 1993 77 p
(Contract NCC2-582)
(NASA-CR-191628; NAS 1.26:191628) Avail: CASI HC A05/MF A01

In this grant period, the focus has been on the effects of thermo-chemical nonequilibrium in low-density gases, and on interactions between such gases and solid surfaces. Such conditions apply to hypersonic flows of re-entry vehicles, and to the expansion plumes of small rockets. Due to the nonequilibrium nature of these flows, a particle approach has been adopted. The method continues to undergo refinement and application to typical flows of interest. A number of studies have been performed for flows in thermo-chemical nonequilibrium. The effects of vibrational nonequilibrium on the rate of dissociation were studied for diatomic nitrogen. It was found that a new model reproduced the nonequilibrium behavior observed experimentally. Author

N93-16596*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A REALIZABLE REYNOLDS STRESS ALGEBRAIC EQUATION MODEL
Tsan-Hsing Shih, Jiang Zhu, and John L. Lumley (Cornell Univ., Ithaca, NY.) Jan. 1993 36 p Presented at the Ninth Symposium on Turbulence Shear Flows, Kyoto, Japan, 10-18 Aug. 1993
(NASA Order C-99066-G; RTOP 505-62-21)
(NASA-TM-105993; ICOMP-92-27; E-7525; NAS 1.15:105993; CMOTT-92-14) Avail: CASI HC A03/MF A01

The invariance theory in continuum mechanics is applied to analyze Reynolds stresses in high Reynolds number turbulent flows. The analysis leads to a turbulent constitutive relation that relates the Reynolds stresses to the mean velocity gradients in a more general form in which the classical isotropic eddy viscosity model is just the linear approximation of the general form. On the basis of realizability analysis, a set of model coefficients are obtained which are functions of the time scale ratios of the turbulence to the mean strain rate and the mean rotation rate. The coefficients will ensure the positivity of each component of the mean rotation rate. These coefficients will ensure the positivity of each component of the turbulent kinetic energy - realizability that most existing turbulence models fail to satisfy. Separated flows over backward-facing step configurations are taken as applications. The calculations are performed with a conservative finite-volume method. Grid-independent and numerical diffusion-free solutions are obtained by using differencing schemes of second-order accuracy on sufficiently fine grids. The calculated results are compared in detail with the experimental data for both mean and turbulent quantities. The comparison shows that the present proposal significantly improves the predictive capability of K-epsilon based two equation models. In addition, the proposed model is able to simulate rotational homogeneous shear flows with large rotation rates which all conventional eddy viscosity models fail to simulate. Author

N93-16625*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF A ROTATING PROPELLER ON THE SEPARATION ANGLE OF ATTACK AND DISTORTION IN DUCTED PROPELLER INLETS
D. R. Boldman, C. Iek, D. P. Hwang, M. Larkin (Pratt and Whitney Aircraft, East Hartford, CT.), and P. Schweiger (Pratt and Whitney Aircraft, East Hartford, CT.) Jan. 1993 16 p Presented at the 31st Aerospace Sciences Meeting and Exhibit, Reno, NV, 11-14 Jan. 1993; Sponsored by AIAA
(RTOP 505-03-10)
(NASA-TM-105935; E-7451; NAS 1.15:105935; AIAA Paper 93-0017)
Avail: CASI HC A03/MF A01

The present study represents an extension of an earlier wind tunnel experiment performed with the P&W 17-in. Advanced Ducted Propeller (ADP) Simulator operating at Mach 0.2. In order to study the effects of a rotating propeller on the inlet flow, data were obtained in the UTRC 10- by 15-Foot Large Subsonic Wind Tunnel with the same hardware and instrumentation, but with the propeller removed. These new tests were performed over a range of flow rates which duplicated flow rates in the powered simulator program. The flow through the inlet was provided by a remotely located vacuum source. A comparison of the results of this flow-through study with the previous data from the powered simulator indicated that in the conventional inlet the propeller produced an increase in the separation angle of attack between 4.0 deg at a specific flow of 22.4 lb/sec-sq ft to 2.7 deg at a higher specific flow of 33.8 lb/sec-sq ft. A similar effect on separation angle of attack was obtained by using stationary blockage rather than a propeller. Author

N93-16627*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
VORTEX BREAKDOWN INCIPIENCE: THEORETICAL CONSIDERATIONS
Stanley A. Berger and Gordon Erlebacher Washington Nov. 1992 27 p Submitted for publication
(Contracts NAS1-18605; NAS1-19480; RTOP 505-90-52-01)
(NASA-CR-189734; ICASE-92-63; NAS 1.26:189734) Avail: CASI HC A03/MF A01

The sensitivity of the onset and the location of vortex breakdowns in concentrated vortex cores, and the pronounced tendency of the breakdowns to migrate upstream have been characteristic observations of experimental investigations; they have also been features of numerical simulations and led to questions about the validity of these simulations. This behavior seems to be inconsistent with the strong time-like axial evolution of the flow, as expressed explicitly, for example, by the quasi-cylindrical approximate equations for this flow. An order-of-magnitude analysis of the equations of motion near breakdown leads to a modified set of governing equations, analysis of which demonstrates that the interplay between radial inertial, pressure, and viscous forces gives an elliptic character to these concentrated swirling flows. Analytical, asymptotic, and numerical solutions of a simplified non-linear equation are presented; these qualitatively exhibit the features of vortex onset and location noted above. Author

N93-16634 ESDU International Ltd., London (England).
DRAG DUE TO GAPS ROUND UNDEFLECTED TRAILING-EDGE CONTROLS AND FLAPS AT SUBSONIC SPEEDS Abstract Only
Nov. 1992 12 p
(ESDU-92039; ISBN-0-85679-847-9) Avail: ESDU

ESDU 92039 discusses the qualitative effects of control gaps on wing aerodynamic characteristics, explains the sources of drag, and considers the benefits of sealing. The effects of wing section and control section

profile mismatch on control gap drag are also considered. The limited data in the literature are used to develop empirical prediction methods for the drag due to unsealed spanwise gaps while for unsealed chordwise gaps, for which the data are too few to be correlated, guidelines on upper limits to drag are given. Methods of allowing for the effect of sealing are suggested in both cases. The data apply to controls or flaps with ratios of control or flap chord to wing chord of 0.1 to 0.3 at the control or flap mid span and hinge lines swept by up to 30 degrees. The methods apply to wing lift coefficients between 0 and 0.6 and are independent of Mach number (provided the flow is everywhere subsonic) and of Reynolds number for gap depth to width ratios equal to or exceeding 3. The accuracy of the methods is assessed, and sketches compare experimental values with prediction. A worked example illustrates the use of the methods and highlights the need for gap sealing. Author

N93-16638 ESDU International Ltd., London (England).
CONTRIBUTION OF VENTRAL FINS TO SIDEFORCE AND YAWING MOMENT DERIVATIVES DUE TO SIDESLIP AT LOW ANGLE OF ATTACK Abstract Only
Nov. 1992 37 p
(ESDU-92029; ISBN-0-85679-835-5) Avail: ESDU

ESDU 92029 applies at subsonic speeds to configurations with a body- or fin-mounted tailplane and a main fin in the plane of symmetry for angles of attack and sideslip up to 5 and 4 degrees respectively. The method is an empirical modification of long-standing theoretical calculations that allow for the interference of body, wing, tailplane and main fin. The sideforce is obtained from the lift-curve slope (from ESDU 70011 at subsonic speeds or 70012 at supersonic speeds, or from slender body theory for low aspect ratios, empirically modified) factored by the appropriate interference factor. The yawing moment derivative is calculated by taking the point of action of the sideforce at quarter- or mid-point of a chord 0.4 of the heights of the fin from the root; more precise methods resulted in little improvement in accuracy and so did not warrant the greater complexity. Sketches comparing predictions with experimental data extracted from the literature show the accuracy of both derivatives to be within 0.15 plus 15 percent. The ranges of geometry and Mach number for the experimental results are tabulated. Author

N93-16704*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EXPERIMENTAL INVESTIGATION OF AN EJECTOR-POWERED FREE-JET FACILITY
Mary Jo Long Jul. 1992 15 p Presented at the 28th Joint Propulsion Conference, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, ASME, SAE, and ASEE Previously announced in IAA as A92-54058
(RTOP 537-02-23)
(NASA-TM-105868; E-7331; NAS 1.15:105868; AIAA Paper 92-3569)
Avail: CASI HC A03/MF A01

NASA Lewis Research Center's (LeRC) newly developed Nozzle Acoustic Test Rig (NATR) is a large free-jet test facility powered by an ejector system. In order to assess the pumping performance of this ejector concept and determine its sensitivity to various design parameters, a 1/5-scale model of the NATR was built and tested prior to the operation of the actual facility. This paper discusses the results of the 1/5-scale model tests and compares them with the findings from the full-scale tests. Author

N93-16710*# Vigyan Research Associates, Inc., Hampton, VA.
MODIFICATIONS TO LANGLEY 0.3-m TCT ADAPTIVE WALL SOFTWARE FOR HEAVY GAS TEST MEDIUM, PHASE 1 STUDIES
A. V. Murthy Dec. 1992 42 p
(Contract NAS1-18585; RTOP 505-59-86-02)
(NASA-CR-189736; NAS 1.26:189736) Avail: CASI HC A03/MF A01

The scheme for two-dimensional wall adaptation with sulfur hexafluoride (SF6) as test gas in the NASA Langley Research Center 0.3-m Transonic Cryogenic Tunnel (0.3-m TCT) is presented. A unified version of the wall adaptation software has been developed to function in a dual gas operation mode (nitrogen or SF6). The feature of ideal gas calculations for nitrogen operation is retained. For SF6 operation, real gas properties have been computed using the departure function technique. Installation of the software on the 0.3-m TCT ModComp-A computer and preliminary validation with nitrogen operation were found to be satisfactory. Further validation and improvements to the software will be undertaken when the 0.3-m TCT is ready for operation with SF6 gas. Author

N93-16940*# Vigyan Research Associates, Inc., Hampton, VA.
DESIGN OPTIMIZATION OF NATURAL LAMINAR FLOW BODIES IN COMPRESSIBLE FLOW
Simha S. Dodbele Washington Dec. 1992 20 p
(Contract NAS1-18585; RTOP 505-59-10-02)
(NASA-CR-4478; NAS 1.26:4478) Avail: CASI HC A03/MF A01

An optimization method has been developed to design axisymmetric body shapes such as fuselages, nacelles, and external fuel tanks with increased transition Reynolds numbers in subsonic compressible flow. The new design method involves a constraint minimization procedure coupled with analysis of the inviscid and viscous flow regions and linear stability analysis of the compressible boundary-layer. In order to reduce the computer time, Granville's transition criterion is used to predict boundary-layer transition and to calculate the gradients of the objective function, and linear stability theory coupled with the e(exp n)-method is used to calculate the objective function at the end of each design iteration. Use of a method to design an axisymmetric body with extensive natural laminar flow is illustrated through the design of a tiptank of a business jet. For the original tiptank, boundary layer transition is predicted to occur at a transition Reynolds number of 6.04 x 10(exp 6). For the designed body shape, a transition Reynolds number of 7.22 x 10(exp 6) is predicted using compressible linear stability theory coupled with the e(exp n)-method. Author

N93-16942*# Scientific Research Associates, Inc., Glastonbury, CT.
TWO- AND THREE-DIMENSIONAL BLADE VORTEX INTERACTIONS
F. Davoudzadeh, N.-S Liu, W. R. Briley, R. C. Buggeln, and S. J. Shamroth Aug. 1990 222 p Original contains color illustrations
(Contract NAS2-12635)
(NASA-CR-177567; A-90275; NAS 1.26:177567) Avail: CASI HC A10/MF A03; 60 functional color pages

A three-dimensional time dependent Navier-Stokes analysis was applied to the rotor blade vortex interaction (BVI) problem. The numerical procedure is an iterative implicit procedure using three point central differences to represent spatial derivatives. A series of calculations were made to determine the time steps, pseudo-time steps, iterations, artificial dissipation level, etc. required to maintain a nondissipative vortex. Results show the chosen method to have excellent non-dissipative properties provided the correct parameters are chosen. This study was used to set parameters for both two- and three-dimensional blade vortex interaction studies. The two-dimensional study considered the interaction between a vortex and a NACA0012 airfoil. The results showed the detailed physics during the interaction including the pressure pulse propagating from the blade. The simulated flow physics was qualitatively similar to that experimentally observed. The 2-D BVI phenomena is the result of the buildup and violent collapse of the shock waves and local supersonic pockets on the blade surfaces. The resulting pressure pulse build-up appears to be centered at the blade leading edge. The three-dimensional interaction study considered the case of a vortex at 20 deg incidence to the blade leading edge. Although the qualitative results were similar to that of the two-dimensional interaction, details clearly showed the three-dimensional nature of the interaction process. Author

N93-17542# Institut de Mecanique des Fluides de Lille (France).
EFFECT OF REYNOLDS NUMBER ON THE STANDARDS OF A SIMPLIFIED ANEMOCLINOMETRIC PROBE [EFFET DU REYNOLDS SUR L'ETALONNAGE D'UNE SONDE ANEMOCLINOMETRIQUE SIMPLIFIEE]
A. Ottavy and P. Bailleux 4 Sep. 1991 33 p In FRENCH
(Contract DRET-89-003-17)
(IMFL-91-31; ETN-92-92556) Avail: CASI HC A03/MF A01

The effect of Reynolds number on the standard characteristics of a flow velocity measuring probe is investigated. An anemoclinometer is a system able to measure velocity flow vector from pressure flow data. The aim is to verify whether each different flow velocity should be associated to a different standard or not. The calculations were performed for angles between -50 to +50 deg. The results are compared to those obtained from a spherical probe. In order to evaluate the accuracy, dispersion error calculations were peformed at small angles. Similar results were obtained

by using a classic calculation method. The maximal deviation calculated was of about 1 deg, for all the different Reynolds numbers used. The results show that the probe can perform measurements in variable velocity flows, in a complex flow and large angular fields. ESA

N93-17543# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.
HOT EXPERIMENTAL TECHNIQUE: A NEW REQUIREMENT OF AEROTHERMODYNAMICS
E. H. Hirschel 9 Mar. 1992 18 p Presented at NATO Advanced Research Workshop on New Trends in Instrumentation for Hypersonic Research, Le Fauga, Italy, 27 Apr. - 1 May 1992
(MBB-FE-202-S-PUB-480; ETN-92-92574) Copyright Avail: CASI HC A03/MF A01

The flow past hypersonic vehicles causes large heat loads on the vehicle surface. It is shown that the heat loads and the flow properties are strongly coupled if radiation cooling is employed. Similar phenomena occur in interacting flows and in nonequilibrium viscous flows. The large demands on ground facility simulation of hypersonic flows make new methods in experimental work necessary. A hot experimental technique, each for three different typical measurement problems, is proposed. Details of the technique, regarding the tunnel type, model, and measurement techniques are discussed. A stepwise approach to the involved problems is suggested. ESA

N93-17568# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
CURRENT EUROPEAN ROTORCRAFT RESEARCH ACTIVITIES ON DEVELOPMENT OF ADVANCED CFD METHODS FOR THE DESIGN OF ROTOR BLADES (BRITE/EURAM DACRO PROJECT)
G. Polz 1991 11 p Presented at 17th European Rotorcraft Forum, Berlin, Germany, 24-27 Sep. 1991; sponsored by DGLR Previously announced in IAA as A92-56332
(MBB-UD-0601-91-PUB; ETN-92-92578) Avail: CASI HC A03/MF A01

Work performed up to now in the BRITE/EURAM Pilot Phase project DACRO is described. Focus is on the development and validation of new Computational Fluid Dynamics (CFD) codes for application to the aerodynamic environment of helicopter rotor blades. Additional tasks are the reviewing of the current computational methods, the definitions of possible improvements, and the selection of appropriate data bases for code validation. The theories applied by the partners are: transonic small perturbation theory; unsteady full potential theory; and Euler methods. Based on these theories, the development of new codes and the improvement of existing codes was undertaken by the partners. Methods in use are described and the progress achieved up to now is demonstrated. ESA

N93-17677# Naval Postgraduate School, Monterey, CA.
A MULTI-FACETED ENGINEERING STUDY OF AERODYNAMIC ERRORS OF THE SERVICE AIRCRAFT INSTRUMENTATION PACKAGE (SAIP) M.S. Thesis
Joseph W. Rixey Sep. 1992 119 p
(AD-A258059) Avail: CASI HC A06/MF A02

The general objectives of this research are to investigate, identify, and quantify the aerodynamic sources of altitude determination errors of the U.S. Navy's Service Aircraft Instrumentation Package (SAIP) and to make recommendations to remedy these errors. This multi-faceted study includes aero-panel methods, computational fluid dynamics (CFD), wind tunnel testing, and flight test evaluations. The Airflow Sensor Assembly (ASA), a device similar to a calibrated pitot static tube, was intended to meet the SAIP's required specifications for altitude determination. However, the ASA is housed in the five inch diameter body of the SAIP and mounted on a variety of host aircraft. The over-pressure generated by the SAIP body as well as the wing/pylon system engulf the static pressure ports creating altitude errors well out of performance limits. This over-pressure associated with these bodies was apparently not accounted for during design and acquisition and extensive modifications will be needed to offset or eliminate their effects. GRA

N93-17756# Naval Postgraduate School, Monterey, CA.
FLOWFIELD COMPUTATIONS OVER THE SPACE SHUTTLE ORBITER WITH A PROPOSED CANARD AT A MACH NUMBER OF 5.8 AND 50 DEG ANGLE OF ATTACK M.S. Thesis
William H. Reuter Jun. 1993 47 p
(AD-A258058) Avail: CASI HC A03/MF A01

Advances in computational fluid dynamics (CFD) capabilities in the last decade have allowed engineers to better analyze cases of hypersonic flight. The Space Shuttle Orbiter has increased over 30,000 pounds in weight since its initial design in 1974, resulting in limitations on its operational capability. One of these limitations is the allowable forward center of gravity location resulting from lateral-directional and longitudinal controllability constraints. One method to relax this limitation is to employ the use of a canard. A canard can produce the additional nose-up pitching moment to relax the center of gravity constraint as well as alleviate the need for large, lift-destroying elevon deflections required to maintain the high angles of attack required for effective hypersonic flight. A configuration is developed using known Orbiter aerodynamic data and a canard computational grid is generated. The Orbiter-canard configuration is analyzed at a Mach number of 5.8 and angle of attack of 50 degrees using flowfields generated by the OVERFLOW three-dimensional computer code. Comparison is made with a baseline solution and results are presented. GRA

N93-16765*# Illinois Univ., Chicago. Dept. of Mechanical Engineering.
INTERFEROMETRIC RECONSTRUCTION OF THREE-DIMENSIONAL HIGH-SPEED AERODYNAMIC FLOWS
Soyoung Stephen Cha *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 91-92 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16768*# Missouri Univ., Rolla. Dept. of Mechanical and Aerospace Engineering.
PRELIMINARY EFFORTS TOWARD DEVELOPMENT OF DATA HANDLING AND ANALYSIS SOFTWARE FOR UNSTEADY FLOW MEASUREMENTS: AN APPLICATION FOR AEROELASTIC TRANSONIC FLOW CONFIGURATIONS
Fathi Finaish *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 99-105 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

N93-16770*# Wilkes Coll., Wilkes-Barre, PA. Dept. of Mechanical Engineering.
WIND TUNNEL SEEDING PARTICLES FOR LASER VELOCIMETER
Anthony Ghorieshi *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 110-115 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

N93-16784*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
DIGITAL DATA ACQUISITION AND PRELIMINARY INSTRUMENTATION STUDY FOR THE F-16 LAMINAR FLOW CONTROL VEHICLE
Cyrus Ostowari *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 157-163 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

N93-16787*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
BOUNDARY-LAYER MEASUREMENTS ON A HIGH REYNOLDS NUMBER THREE-ELEMENT AIRFOIL
Gregory V. Selby *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 171-172 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16797*# California State Univ., Los Angeles. Dept. of Mechanical Engineering.
NAVIER-STOKES CALCULATION OF TRANSONIC FLOW PAST THE NTF 65-DEG DELTA WING
Chivey Wu *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 191-199 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N93-16455# Wichita State Univ., KS. National Inst. for Aviation Research.

AVIATION SAFETY RESEARCH AT THE NATIONAL INSTITUTE FOR AVIATION RESEARCH WICHITA STATE UNIVERSITY: A REPORT TO THE FAA TECHNICAL CENTER

William H. Wentz, John J. Hutchinson, and David R. Ellis Feb. 1992 120 p

(NIAR-92-2) Avail: CASI HC A06/MF A02

Viewgraphs of a report presented to the FAA Technical Center on Aviation Safety Research is included. Topics covered include a review of 1990 contract tasks, report of 1989 contract, program plan for 1991 contract, follow-on items, and schedule for next program review. These projects covered topics such as scratch effects on fatigue of new alloys; survey of automated scanning and robotics system for aircraft inspection; crash analysis of aircraft seats; toward standardization of design procedures for rotor containment - turbine engine failure; and failure mechanisms in composite structures manufactured using contemporary techniques.

L.R.R.

N93-16834# National Transportation Safety Board, Washington, DC.

SPECIAL INVESTIGATION REPORT: FLIGHT ATTENDANT TRAINING AND PERFORMANCE DURING EMERGENCY SITUATIONS

9 Jun. 1992 59 p

(PB92-917006; NTSB/SIR-92/02) Avail: CASI HC A04/MF A01

This report reviews recent aviation accidents and incidents, Federal Aviation Regulations related to flight attendant training, and flight attendant training programs from 12 air carriers. Evidence from recent accident and incident investigations revealed that some flight attendants did not perform emergency duties in accordance with their air carrier training programs. The Safety Board believes that the ability of flight attendants to perform their duties successfully during emergency situations is directly related to the quality of their emergency training. As a result of this special investigation, the Safety Board issued 13 recommendations to the FAA about flight attendant training.

GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N93-15988# Naval Postgraduate School, Monterey, CA.

CORRECTION OF INERTIAL MEASUREMENTS USING GPS UPDATES FOR UNDERWATER NAVIGATION M.S. Thesis

Steve Nagengast Sep. 1992 104 p

(AD-A257329) Avail: CASI HC A06/MF A02

An Autonomous Underwater Vehicle (AUV) can combine a Global Positioning System (GPS) receiver with an Inertial Navigation System (INS) to navigate with a specified accuracy level. The AUV would be required to surface periodically to obtain a GPS fix. A computer simulation has been developed using an AUV model and an INS error model to generate noisy measurements. A Kalman filter is used to estimate the simulated INS errors. Several runs were executed to compare combinations of equipment with different levels of accuracy.

GRA

N93-16141# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.

REAL-TIME IONOSPHERIC MONITORING SYSTEM USING THE GPS

A. J. Coster, E. M. Gaposchkin, and L. E. Thornton 24 Aug. 1992 35 p

(Contract F19628-90-C-0002)

(AD-A256916; TR-954; ESC-TR-91-179) Avail: CASI HC A03/MF A01

In satellite tracking using ground-based radars, an estimate of the total electron content (TEC) along the path to the satellite is required to measure accurately the range of the satellite. This estimate is necessary because the radar wave travels at a slower speed as it propagates through the ionosphere. The range error Delta R that is introduced is dependent on the radar frequency f and on the TEC along the propagation path, and can be expressed by where Ne is the local electron density and R is the radar range. The TEC can vary significantly with the time of day, geomagnetic activity, and look direction. A real-time synoptic ionospheric monitoring system has been developed using data acquired from a T14100 Global Positioning System (GPS) receiver for use at the Millstone Hill satellite-tracking radar. The T14100 GPS receiver can track up to four GPS satellites at any one time. Each GPS satellite transmits signals at two different L-band frequencies: L1 (1575.42 MHz) and L2 (1227.6 MHz). Ne TEC along the path to each satellite can be determined by combining both frequencies using the pseudorange and the integrated phase data. At Millstone, the TEC is measured every 3 s for each GPS satellite in view.

GRA

N93-16209# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

POSITIONING OF THE TROMSO STATION (NORWAY) BY SATELLITE LASER RANGING; CAMPAIGN 1990 DATA ACQUISITION AND ANALYSIS

B. A. C. Ambrosius, ed., J. A. Bax, B. H. W. vanGelder, D. L. F. vanLoon, R. Noomen, A. J. M. Verheijen, E. Vermaat, and K. F. Wakker Nov. 1991 52 p

(LR-668; MFG-91-5; ISBN-91-6275-745-6; ETN-92-92867) Copyright Avail: CASI HC A04/MF A01

Activities performed during the deployment of the Dutch Modular Transportable Laser Ranging System (MTLRS-2) at Tromso (Norway) in the Summer of 1990 and the analysis of data acquired at the site together with data from the European and global Satellite Laser Ranging (SLR) network, are summarized. Final results of the data analysis are presented. The aim was to determine the Norwegian reference station at Tromso in the global SLR reference frame. MTLRS-2 successfully observed a total of 49 usable passes of the geodetic satellite Lageos. Different techniques were applied to process these observations which resulted in the solutions of the coordinate of the SLR monument at Tromso.

ESA

N93-16213# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

TERMINAL AREA TRAFFIC MANAGEMENT

H. G. Visser Jun. 1992 67 p

(LR-684; ETN-92-92878) Avail: CASI HC A04/MF A01

Time based traffic management procedures that were proposed to increase the capacity of the air traffic system by the beginning of the next century are considered. Today's air traffic control systems are described. Their shortcomings are identified and the need for improved systems and procedures is discussed. The new technologies which will enable the limitations of the present communication, navigation and surveillance systems to be overcome by providing higher quality and improved efficiency, are discussed. Because terminal area management is certainly one of the most critical aspects of overall air traffic management, the main focus is on this issue. Current research efforts towards improved trajectory optimization and control for flight operations in an extended terminal area are described.

ESA

N93-16343# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

DME-DERIVED POSITIONS COMPARED WITH MLS- AND ILS-DERIVED POSITIONS

P. J. Hoogeboom Mar. 1990 38 p Sponsored by Dept. of Civil Aviation

(NLR-TP-90119-U; ETN-93-92859) Avail: CASI HC A03/MF A01

From Distance Measurement Equipment (DME) data recorded during Microwave Landing System (MLS) flight trials, the positions of the aircraft was determined by postprocessing and compared with the MLS and Instrument Landing System (ILS) derived positions. An empirical determination of the expected accuracy of a rho-rho DME solution is reported. The difference between the DME position and the MLS (or ILS) position is presented. The predicted DME position error deviates slightly from the

data analysis results. The main characteristics of the model was reflected by the results at an intersection angle between the distances of about 30 degrees. The position error is about four times larger than at an intersection angle of 90 degrees. When using a rho-rho DME position solution to navigate in the vicinity of an airfield at low altitudes, reliability problems with the used DME distances can be experienced due to line of sight problems. Depending on the intersection angle between the distances, the position determination error will be in the order of 500 to 1000 m. Compared with an MLS derived position, the DME position error is at least an order of magnitude larger. ESA

N93-16402# Aeronautical Research Labs., Melbourne (Australia).
REVIEW OF TECHNIQUES FOR IN-FLIGHT TRANSFER ALIGNMENT: GUIDED WEAPONS TECHNICAL MEMORANDUM NO. 012
M. B. Pszczel and D. Bucco Jun. 1992 45 p
(AD-A256316; ARL-GW-TM-012; DODA-AR-006-667) Avail: CASI HC A03/MF A01

This report presents methods for transfer alignment (TA) of inertial navigation systems (INS) which have been published in the accessible literature during the last three decades. Kalman filtering techniques based on linearized dynamics dominated in the literature of the subject. Methods of TA can be classified as angular rates, velocity or position matching. In each case, a number of assumptions are made to ensure the validity of proposed techniques. The accuracy of filters depends on the particular implementation viz. allowable maneuvers and time of TA, microprocessor used, vibration environment, inclusion of wing flexure into the model, type of application under discussion (range of missile or time of flight), quality of output from inertial measurement units, etc. Authors briefly discuss methods of in-flight transfer alignment of INS taking into account these assumptions. GRA

N93-16498# Federal Aviation Administration, Atlantic City, NJ.
THE EFFECT OF TCAS INTERROGATIONS ON THE CHICAGO O'HARE ATCRBS SYSTEM Final Report, 5-6 May and 20-23 Jul. 1992
Leo Wapelhorst, Thomas Pagano, and John VanDongen Nov. 1992 42 p
(DOT/FAA/CT-92/22) Avail: CASI HC A03/MF A01

This report documents the Federal Aviation Administration (FAA) data collection and analysis effort to investigate Secondary Surveillance Radar (SSR) problems encountered at the Chicago O'Hare Terminal Approach Control (TRACON) facility. The FAA has mandated the implementation of Traffic Alert and Collision Avoidance System (TCAS) II to the entire air transport fleet by December 31, 1993. To provide for the smooth and orderly implementation of TCAS II, the TCAS Transition Program has been established to accomplish these objectives. The FAA Technical Center Research Directorate for Aviation Technology, ACD-320, conducted the investigation by developing the data collection system capability of the Data Link Test and Analysis System (DATAS). Two distinct capabilities were developed to monitor the uplink and downlink activity of the SSR system frequencies. The uplink data collection system is an airborne installation of Digital Link Test and Analysis Systems (DATAS) on an FAA aircraft and test flights were conducted to obtain the uplink data. The downlink data collection system was installed at the ground radar facility to monitor the Air Traffic Control Radar Beacon System (ATCRBS) receiver signal for downlink analysis. Data results and analysis of both efforts are documented herein. Author

N93-16692*# Vigyan Research Associates, Inc., Hampton, VA.
PILOT WEATHER ADVISOR
W. A. Kilgore, S. Seth, N. L. Crabill (Aero Space Consultants, Newport News, VA.), S. T. Shipley (Hughes STX, Inc., Lanham, MD.), I. Graffman (Hughes STX, Inc., Lanham, MD.), and J. ONeill (NIALL Enterprises, Belmont, WI.) Nov. 1992 43 p
(Contract NAS1-19250; RTOP 324-01-00)
(NASA-CR-189723; NAS 1.26:189723) Avail: CASI HC A03/MF A01

The results of the work performed by ViGYAN, Inc., to demonstrate the Pilot Weather Advisor cockpit weather data system using a broadcast satellite communication system are presented. The Pilot Weather Advisor demonstrated that the technical problems involved with transmitting significant amount of weather data to an aircraft in-flight or on-the-ground via satellite are solvable with today's technology. The Pilot Weather Advisor appears to be a viable solution for providing accurate and timely weather information for general aviation aircraft. Author

N93-16841# Federal Aviation Administration, Atlantic City, NJ.
RESULTS OF DATAS INVESTIGATION OF ILLEGAL MODE S ID'S AT JFK AIRPORT Final Report, 25 Aug. - 29 Sep. 1992
Thomas Pagano, John VanDongen, and Leo Wapelhorst Dec. 1992 18 p
(DOT/FAA/CT-92/26) Avail: CASI HC A03/MF A01

This report documents the second deployment of the Data Link Test and Analysis System (DATAS) as a Traffic Alert and Collision System (TCAS) monitor. The purpose was to identify aircraft which were reporting Illegal Mode Select (Mode S) ID's. The project was conducted by the Research Directorate for Aviation Technology, Airborne Collision Avoidance & Data systems Branch, Federal Aviation Administration (FAA) Technical Center. Author

N93-17559# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
NAVSTAR GLOBAL POSITIONING SYSTEM: INTRODUCTION AND STATUS
O. B. M. Pietersen 25 Jan. 1991 13 p Presented at NERG Meeting on Satellite Navigation, Amsterdam, Netherlands, 6 Nov. 1991
(NLR-TP-91008-U; ETN-92-92511) Avail: CASI HC A03/MF A01

A general description of the Navstar Global Positioning System (GPS), a space based radio positioning system which provides suitably equipped users with highly accurate position, velocity, and time data, is given. The technical characteristics of the space segment, control segment, and user segment are described. The status of the three segments is given as existing at the end of 1990. The system performance and GPS satellite signals are discussed. ESA

N93-17584# Technische Univ., Delft (Netherlands).
CARRIER WAVE SIGNALS INTERFERING WITH LORAN-C Ph.D. Thesis
Martin Beckmann 1992 167 p
(ETN-92-92528) Avail: CASI HC A08/MF A02

The interference problems on the Loran C radio navigation system is analyzed. The problems and a description of the effects of interference in Loran C are discussed. The description fills a gap in the numerical analysis of the influence of interference on Loran C. It shows that for further expansion of Loran C especially in western Europe, solutions to the interference problems are needed. Two types of interference to Loran C are distinguished and their effects on positioning are described. The attention is also focused on interference from nonLoran C transmissions in the frequency bands around the Loran C spectrum. This type of interference can be attacked at two levels: in the Loran C system by properly choosing system parameters, and in Loran C receivers by including all kinds of filtering techniques to remove the unwanted signals. For both levels, methods for interference reduction have been developed. It is shown that the largest problem is the proper detection of harmful interference signals, while rejection of signals is relatively easy with todays technology. A new concept for detecting all interference harmful to a Loran C chain, based on digital signal processing of antenna signals with very powerful processors, is presented. ESA

N93-17311*# Berry Coll., Mount Berry, GA. Dept. of Physics.
MULTIPATH EFFECTS IN A GLOBAL POSITIONING SATELLITE SYSTEM RECEIVER
Malcolm W. McDonald *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N93-15681# Army Lab. Command, Watertown, MA. Material Technology Lab.

FAILURE ANALYSIS OF THE MAIN ROTOR RETENTION NUT FROM AH-64 HELICOPTER Final Report

Milton Levy, Paul Buckley, John Beatty, Richard Brown, and Robert Huie Jun. 1992 29 p

(AD-A256815; MTL-TR-92-39) Avail: CASI HC A03/MF A01

An inspection of the entire fleet of Apache helicopters revealed that eight nuts contained cracks. The goals were to determine the failure mode and cause, to establish the mechanical and corrosion properties of the nut material, to verify that cadmium and nickel coatings were applied in accordance with the specification requirements, and to make appropriate recommendations to prevent further problems. Additional nuts from both the inventory and field were characterized and tested for comparison. The following analyses and tests were performed: visual examination; light and electron microscopy of the retention nuts and fracture surfaces; metallographic analysis of both failed and intact nuts; chemical analysis of the 18 Nickel maraging steel C-250 grade steel; and mechanical property, stress corrosion, and electrochemical tests. The chemical composition of the steel was well within the contractors specification and met the industry standards for maraging C-250 grade steel. Mechanical properties were also within specified requirements. Hydrogen-assisted cracking was the cause of all cracks found in the retention nuts. GRA

N93-15858# Rutgers - The State Univ., Newark, NJ. Dept. of Physics.

F-14 WING LUG COATING INVESTIGATION Final Report, Sep. 1991 - Mar. 1992

Donald J. Hirst and Charles R. Hegedus 15 Feb. 1992 26 p Sponsored by Naval Air Systems Command

(AD-A257384; NAWCADWAR-92045-60) Avail: CASI HC A03/MF A01

F-14 wing lugs have been painted with a special coating which prevents wear of the bearing and lug, and subsequent failure of the wing. The coating originally designated for this application contained talcs (extender pigments) which contain small concentrations of asbestos, causing discontinued manufacturing of the talcs and the coating. Since the performance of this coating is considered critical to flight, a replacement was needed to prevent grounding of the F-14 fleet. One requirement for the application of this coating was that it be processed by allowing the filler particles to settle, and subsequently decanting and applying the resin-rich upper layer of the mixed coating. The original coating was reformulated by replacing the talcs with non-asbestos pigments with nearly equivalent chemical composition. This resulted in a pigment systems which does not settle an much as that in the original coating, and the applied film is far less wear resistant. Alternative high performance coatings also displayed relatively poor abrasion resistance compared to the original coating. A mechanism for these results has been proposed. It is suspected that pigment-rich coatings with particles protruding through the surface allow the concentration of shear stresses. GRA

N93-16186# Systems Technology, Inc., Hawthorne, CA.

GROUND BASED SIMULATION EVALUATION OF THE EFFECTS OF TIME DELAYS AND MOTION ON ROTORCRAFT HANDLING QUALITIES Final Report, 16 Jul. - 17 Aug. 1990

David G. Mitchell, Roger H. Hoh, Adolph Atencio, Jr., and David L. Key Jan. 1992 247 p Sponsored by Army Aviation Systems Command

(AD-A256921; Rept-1281-10-1; AVSCOM-TR-91-A-010) Avail: CASI HC A11/MF A03

An exploratory simulation was conducted on the NASA Ames Research Center's Vertical Motion Simulator (VMS) to evaluate the effects of simulator characteristics on handling qualities for performing hover and low-speed tasks in a helicopter. The primary focus of the study was on subjective assessments of the variations, based on Cooper-Harper Handling Qualities Ratings (HQR's), rather than objective measures of pilot performance. Effects of variations in the three major elements of the simulation (motion system, visual system, and math model) were evaluated. Seven precision and aggressive low speed Mission-Task-Elements were performed. All tasks were Level 2 (average HQR worse than 3.5) fixed-base for the baseline helicopter, which was designed to provide Level 1 handling qualities in the real world. Addition of motion improved ratings 1/2 to 2 points, resulting in Level 1 handling qualities for most tasks. Tradeoffs in motion acceleration gain and washout break frequency were evaluated with two sets of motion washouts. There was a preference for reduced washout frequencies (resulting in improved phasing between the visual and motion responses at mid helicopter, handling qualities, simulation, time delay, motion system to high frequencies, at the sacrifice of onset gain) for the precision tasks. Conversely, there was a slight preference for increased onset gains (at the sacrifice of visual/motion phasing) for the aggressive tasks. The effects on handling qualities of a visual delay compensation algorithm were investigated by three pilots. GRA

N93-16215# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

STRESS CALCULATIONS ON THE WINDOW SECTION OF AN ALL-COMPOSITE AIRCRAFT FUSELAGE

M. J. L. vanTooren, G. A. M. ScholteAlbers, and T. deJong Jul. 1992 103 p

(LR-688; ETN-92-92880) Avail: CASI HC A06/MF A02

An approximate solution for the stresses in an infinite orthotropic plate with a row of holes is presented. The calculations are based on the analytical method of complex stress functions. The complex stress functions are evaluated from the boundary conditions of the holes. The influence of each hole is represented by a Taylor expansion of the elementary stress functions belonging to that hole. The use of series implies a limited accuracy of the solution. The numerical evaluation however shows that the convergence of the series is good. In the stress calculations, arbitrary loading conditions can be applied at infinity and the row of holes can be orientated under an arbitrary angle with the symmetry axes of the material. Here two angles and a loading condition of plane stress were chosen. Numerical results are obtained for five carbon fiber reinforced laminates with three different pitch to hole diameter ratios. The isotropic case was added for reference purposes. A preliminary design of an all composite sandwich fuselage (150 seats) is also investigated. With the analytical method developed before, the required facing thickness for the window section is calculated using a modified Tsai-Hill criterion. The calculations reveal that so far, the window section is most efficiently reinforced with a 1.9 mm Carbon Fiber Reinforced Plastic (CFRP) laminate consisting for 60 percent of (+/- 45 deg) CFRP and for 40 percent of (0 to 90 deg) CFRP. ESA

N93-16262# San Diego State Univ., CA.

COCKPIT RESOURCE MANAGEMENT PROFICIENCY AS A FACTOR OF PRIMARY FLIGHT TRAINING M.S. Thesis

Matthew J. Faletti Jul. 1992 56 p

(Contract N00123-89-G-0591)

(AD-A256995) Avail: CASI HC A04/MF A01

Since the first dual piloted aircraft flew in 1911, aircrew have been attempting to communicate with one another in the cockpit. As aircraft have become more sophisticated, the demands placed on crew members have increased dramatically. Aircrews have become more than manipulators of the controls, they now must consider all factors which may effect a flight from A to B. Often these factors will occur even before the aircraft leaves the ground. However, as the sophistication of aircraft has increased, little attention has been devoted toward the human factor in aviation. Statistics show that flight crews are responsible for approx. 80 pct. of the accidents that occur. The boom in technology and the resulting changing role of flight crew as managers and decision makers rather than continuous manipulators of the controls' have brought about a new term in aviation, Cockpit Resource Management (CRM). CRM attempts to explain and address the need and importance of the communication process in the cockpit, and an analysis of the flight crew as a system, rather than as isolated individuals. With such a large percentage of aircraft accidents resulting from crew error, it is important to ask if CRM skills can be effectively taught to pilots. The effectiveness is addressed of the flight training programs within the Naval Air Training Command at instilling CRM skills to newly designated flight personnel. GRA

N93-16283# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
THE AIRBUS FLOOR BEAM: TOWARDS A COST-EFFECTIVE COMPOSITE DESIGN AND MANUFACTURE RESEARCH PROJECT SPONSORED BY AIRBUS INDUSTRY
R. E. deKok Jan. 1992 62 p
(LR-677; ETN-92-92872) Avail: CASI HC A04/MF A01

The feasibility of the use of Continuous Fiber Reinforced Thermo Plastic (CFRTP) materials in primary load bearing aircraft structures is considered. The possibility of replacing aluminum floor beams with cost effective composite floor beams was investigated. Both the design and the manufacturing technology for a composite floor beam were studied. A typical 'square u' shaped floor beam of the A310 (part identification code 56) was selected initially to be replaced with a composite version which should act as a demonstrator. The restrictions that had to be met with are detailed. The aluminum floor beam is made from one single piece by numerically controlled milling machine. This process facilitates the production of a changing geometry to optimize the strength and stiffness of each beam individually. This method has resulted in a rather complex design for each single floor beam and a very large scrap percentage (approximately 75 percent). The project status is outlined. The design (requirements, calculations, ease of production), the selection of an adequate manufacturing technique and research results on the validation of these processes, are dealt with. It is shown that the specific nature of these materials, their inherent higher unit cost and their processing characteristics necessitate a change in the current design. This will enable the applications of relatively straightforward manufacturing processes and a standard laminate layup in order to arrive at a cost effectice part. ESA

N93-16287# Alenia Spazio S.p.A., Naples (Italy). Gruppo Aerei Trasporto.
REVIEW OF AERONAUTICAL FATIGUE INVESTIGATION ACTIVITIES DEVELOPED IN ALENIA-GAT DURING THE PERIOD MAY 1990 - MARCH 1991
A. Minuto Mar. 1991 10 p Presented at the 5th AIFA Meeting, Parma, Italy, 17-19 Mar. 1991
(ETN-92-92884) Avail: CASI HC A02/MF A01

The main activities carried out by Alenia (Aeritalia and Selenia) GAT (Italian acronym for Air Transport Group) in the field of aeronautical fatigue are summarized. The ATR 42 and 72 full scale fatigue tests are described. These included: aircraft fatigue tests, horizontal tail fatigue tests, main landing gear fatigue tests and main landing gear support structure fatigue tests. The ATR 72 test also investigated rear entry door plug, carbon epoxy vertical tail and skin panels with bonded stringers. The MO 11 full scale a winglet assembly fatigue tests and the specimen fatigue tests are also described. The latter included crack propagation tests and analytical models comparison, fatigue characterization of carbon/epoxy solid laminates, fatigue characterization of aluminun alloys, and damage tolerance charaterization of aluminum lithium alloys. The test setups are illustrated. ESA

N93-16345# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
HELICOPTER INSTALLATIONS: FROM MOTOR TO ROTOR [HELIKOPTER INSTALLATIES: VAN MOTOR TOT ROTOR]
J. F. Boer Dec. 1991 192 p In DUTCH
(LR-675; ETN-93-92870) Avail: CASI HC A09/MF A02

The primary installations of helicopters are described with a view to helicopter design. Some relevant helicopter principles are explained. The different types of engine installations, their fuel control systems, and instrumentation as well as the fuel installation are described. The general requirements for transmission systems, the different transmission configurations and their components, the lubrication of the gear casings, and the suspension of the main deceleration box are treated. Rotor heads, rotor blades, and couple compensation systems are presented. The different helicopter control systems are described. ESA

N93-16396# Orincon Corp., La Jolla, CA.
CONDITIONED BASED MACHINERY MAINTENANCE (HELICOPTER FAULT DETECTION) Progress Report, 1 Jul. - 31 Aug. 1992
27 Aug. 1992 9 p
(Contract N00014-92-C-0059)
(AD-A255796; OC-R-92-U-0349) Avail: CASI HC A02/MF A01

A problem of current interest is the automatic detection and classification of faults in mechanical systems such as the gearboxes and transmissions on board helicopters. Current fault processing uses relatively simple metrics to characterize changes in measured vibration data. The metric specification and thresholds for detection and classification are found using complicated analytic models for the gearboxes. With this approach, finding a solution to the problem is difficult since the understanding of the problem, the metrics that can be used, and the fault classes that are accounted for are only as good as the model developed. In many cases, the interaction of fault conditions with the mechanical system is time varying and highly nonlinear. An alternative solution described here is to use generalized time-frequency and time-scale representations coupled with a hierarchy of neural nets. The processing assumes no underlying model for the events of interest. Rather, the system 'learns' to detect and classify faults by examination and fusion of features from training data which have known fault conditions. Results of processing real helicopter gearbox vibration data with seeded faults are shown. GRA

N93-16404# Aeronautical Research Labs., Melbourne (Australia).
MEASUREMENT OF THE DYNAMIC UNDERCARRIAGE RESPONSE OF A SIKORSKY S-70B-2 HELICOPTER: INSTRUMENTATION AND TEST METHODS: FLIGHT MECHANICS TECHNICAL MEMORANDUM
D. T. Hourigan, F. J. Bird, and C. W. Sutton Jun. 1992 32 p
(AD-A256319; ARL-FLIGHT-MECH-TM-462; DODA-AR-007-082) Avail: CASI HC A03/MF A01

The instrumentation and techniques are described which were used to measure the dynamic undercarriage response of a Royal Australian Navy S-70B-2 Seahawk helicopter. GRA

N93-16562# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
A90 PROJECT: DESIGN OF A COMPOSITE FIN M.S. Thesis
P. D. Friar Apr. 1991 288 p
(ETN-92-92773) Copyright Avail: CASI HC A13/MF A03

The preliminary design of the fin for the A90 project, a civil transport airliner to be manufactured from advanced laminated fiber reinforced plastic composite materials, and which will carry a highset all moving 'T' tailplane, is presented. The fin structure was designed on the normal criteria of strength, stiffness, fatigue, and minimum weight. In addition the following factors were considered: ease of manufacture, use of standard materials, simplicity, impact requirements, accessibility and maintainability, and lightning strike protection. Air loads experienced by the fin are derived and used to produce shear force, bending moment and torque distributions for structural axes parallel and perpendicular to the swept rear spar. These were used as the basis of the structural analysis to design and size the various internal components of the fin, the spar booms, spar webs, skins, ribs and metallic fittings. The practical choice of composite layups is discussed together with the selection of suitable layups for each structural member of the fin. It is concluded that the design of a large fin structure in composite materials is a feasible proposition, and that extensive use of these materials produces worthwhile weight savings. ESA

N93-16632# Office of Technology Assessment, Washington, DC.
MONITORING LIMITS ON SEA-LAUNCHED CRUISE MISSILES
Sep. 1992 39 p
(OTA-ISC-513; ISBN-0-16-038031-6) Avail: CASI HC A03/MF A01; SOD HC

This report is a summary and update of a study, delivered to Congress in July 1991, that examined methods to monitor Soviet compliance with potential bilateral arms control limits on nuclear-armed seal-launched cruise missiles (SLCMs). Information in this report was last updated in November 1991. Author

N93-16635 ESDU International Ltd., London (England).
EXAMPLE OF STATISTICAL TECHNIQUES APPLIED TO ANALYSIS OF LANDING GROUND ROLL DISTANCE MEASUREMENTS (LINEAR REGRESSION, CORRELATION COEFFICIENT AND F-TEST) Abstract Only
Oct. 1992 8 p
(ESDU-92021; ISBN-0-85679-826-6) Avail: ESDU

ESDU 92021 uses the analysis of a set measurements of approach speed and associated landing ground roll distance to illustrate the use of linear, two variable regression. Regression is used twice: firstly, on an empirical basis, a linear relationship is assumed between the two variables, and secondly, taking account of the physics of the maneuver, a linear relationship is assumed between the square of the approach speed and the ground roll. In both cases, the significance of the derived fit is verified using the F variance ratio test and the correlation coefficient. Both fits are found to be excellent, although the latter is clearly the better physical model. An introduction to statistical techniques for use in the analysis of aircraft performance data is given in ESDU 91017. Author

N93-16636 ESDU International Ltd., London (England).
EXAMPLE OF STATISTICAL TECHNIQUES APPLIED TO ANALYSIS OF MEASUREMENTS OF THE LANDING AIRBORNE MANOEUVRE. (MULTIPLE LINEAR REGRESSION WITH TWO INDEPENDENT VARIABLES AND ONE DEPENDENT VARIABLE.) Abstract Only
Oct. 1992 13 p
(ESDU-92022; ISBN-0-85679-827-4) Avail: ESDU

ESDU 92022 uses the analysis of a set of measurements of screen and touchdown speed, rates of descent at the screen and touchdown, and airborne time to illustrate multiple linear regression. In this context it is usual to derive two separate correlations: the relationship between the mean rate of descent and the rates of descent at the screen and touchdown, and the relationship between the ratio and the screen speed to the touchdown speed and the rates of descent at the screen and touchdown. In both cases the significance of the derived fit is verified using the F variance ratio test. The use of the results to derive certification values of airborne distance is discussed. An introduction to statistical techniques for use in the analysis of aircraft performance data is given in ESDU 91017. Author

N93-16947*# McDonnell-Douglas Corp., Long Beach, CA. Development Group.
THE 1990 HIGH-SPEED CIVIL TRANSPORT STUDIES Final Report, 1 Oct. 1989 - 31 Mar. 1991
Oct. 1992 75 p
(Contract NAS1-18378; RTOP 537-01-22-01)
(NASA-CR-189618; NAS 1.26:189618; MDC-K0395-2) Avail: CASI HC A04/MF A01

This summary report contains the results of the Douglas Aircraft Company system studies related to High-Speed Civil Transports (HSCT's). The tasks were performed under an 18-month extension of NASA Langley Research Center Contract NAS1-18378. The system studies were conducted to assess the emission impact of HSCT's at design Mach numbers ranging from 1.6 to 3.2. The tasks specifically addressed an HSCT market and economic assessment, development of supersonic route networks, and an atmospheric emissions scenario. The general results indicated: (1) market projections predict sufficient passenger traffic for the 2000 to 2025 time period to support a fleet of economically viable and environmentally compatible HSCT's; (2) the HSCT route structure to minimize supersonic overland traffic can be increased by innovative routing to avoid land masses; and (3) the atmospheric emission impact on ozone would be significantly lower for Mach 1.6 operations than for Mach 3.2 operations. Author

N93-16999*# McDonnell-Douglas Corp., Long Beach, CA. Development Group.
THE 1990 HIGH-SPEED CIVIL TRANSPORT STUDIES. SUMMARY REPORT Final Report
Oct. 1992 28 p
(Contract NAS1-18378; RTOP 537-01-22-01)
(NASA-CR-189619; NAS 1.26:189619; MDC-K0395-3) Avail: CASI HC A03/MF A01

This report contains the results of the Douglas Aircraft Company system studies related to High-Speed Civil Transports (HSCT's). The tasks were performed under an 18-month extension of NASA Langley Research Center Contract NAS1-18378. The system studies were conducted to assess the emission impact of HSCT's at design Mach numbers ranging from 1.6 to 3.2. In particular, engine cycles were assessed regarding community noise and atmospheric emissions impact, and a HSCT route structure was developed. The general results indicated the following: (1) in the Mach number range 1.6 to 2.5, the development of polymer composite and discontinuous reinforced alumnium materials is essential to ensure a minimum operational weight; (2) the HSCT route structure to minimize supersonic overland can be increased by innovative routing to avoid land masses; (3) at least two engine concepts show promise in achieving sideline stage 3 noise limits; (4) two promising low-NO(x) combustor concepts were identified; (5) the atmospheric emission impact on ozone could be significantly lower for Mach 1.6 operations than for Mach 3.2 operations; and (6) sonic boom minimization concepts are maturing at an encouraging rate. Author

N93-17219# Federal Aviation Administration, Atlantic City, NJ.
AIRCRAFT WING COMPARTMENT LINER CONCEPT TO REDUCE FUEL SPILLAGE
Robert F. Salmon Nov. 1992 31 p
(DOT/FAA/CT-TN92/34) Avail: CASI HC A03/MF A01

A new concept in aircraft fuel tank design is described. The concept has the potential for reducing the spillage from an aircraft fuel tank which has been ruptured during what could be considered a survivable crash. The time element is very critical for survival after a crash. By reducing the amount of fuel spilled during the first minute after the aircraft comes to rest, the probability of passenger survival can be greatly enhanced. The penalties in weight and reduction in fuel capacity resulting from installing the new containment system appear to be minor. The reduction in fuel capacity in a 707 type aircraft, for instance, would be approximately 44 gallons or 0.32 percent of total fuel capacity. Author

N93-17394# National Aerospace Lab., Amsterdam (Netherlands). Structure and Materials Div.
USAGE MONITORING IN THE RNLN FLEET AIR ARM (MARINE LUCHTVAARLDIENST)
A. A. tenHave 5 Mar. 1992 17 p In DUTCH Submitted for publication
(NLR-TP-91070-U; ETN-92-92514) Avail: CASI HC A03/MF A01

The item 'usage monitoring' is worked out and illustrated with some examples. The RNLN (Royal Netherlands Navy) Fleet Air Arm (Marine Aviation Service) recently implemented a series of usage monitoring procedures for the optimization of the Orion patrol aircraft and the Westland Lynx helicopter, with a view to the enhancement of efficiency, economy, and safety of the usage of both aircraft systems. Compared to the benefits, the efforts for achieving useful usage monitoring are relatively small. The RNLN, as a relatively small operator, may be considered one of the leading operators in this respect. ESA

N93-17535# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
REVIEW OF AERONAUTICAL FATIGUE INVESTIGATIONS IN THE NETHERLANDS DURING THE PERIOD MARCH 1989 - MARCH 1991
J. B. deJonge 6 Mar. 1991 34 p Presented at 22d ICAF Conference, Tokyo, Japan, 20-21 May 1991
(NLR-TP-91092-U; ETN-92-92516) Avail: CASI HC A03/MF A01

Within the framework of aeronautical fatigue investigations the following are discussed: fatigue load monitoring of aircraft; test load sequences; crack propagation studies; metallic materials evaluation; full scale certification tests; fatigue of composites; aging aircraft problems; and nondestructive inspection. Where possible, applicable references are presented. ESA

N93-17538# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
LOAD MONITORING OF F-16 A/B AIRCRAFT OF THE RNLAF WITH A SMART ELECTRONIC DEVICE
D. J. Spiekhout 14 Mar. 1991 22 p Presented at AGARD Specialists Meeting on Fatigue Management, Bath, England, May 1991
(NLR-TP-91116-U; ETN-92-92520) Avail: CASI HC A03/MF A01

Load monitoring of F-16 aircraft is described. Since the introduction of the F-16 weapon system in the RNLAF (Royal Netherlands Air Force) load monitoring was carried out with a Mechanical Strain Recorder (MSR) in each aircraft and a Flight Loads Recorder (FLR) in one sixth of the fleet. In 1990 these recorders were replaced by instrumentation which is capable of recording peaks and troughs in the signal of a strain gage at the location of the MSR. This new instrumentation was installed in three aircraft per squadron. Reasons why it was decided to phase out the FLR and MSR instrumentation and replace it with this smart electronic device, are discussed. The set up of the data collecting procedure and actions taken

to ensure the quality of the accumulated data are described. Attention is given to the calculation of the damage, in terms of crack growth, of the recorded load sequences. Examples of the data recorded and subsequent analysis results of the data base are given. Supporting multichannel measurements in which vertical acceleration, wing root bending strain, and a strain at a different structural location were recorded, are considered.
ESA

N93-17562# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
FLIGHT SIMULATION AND CONSTANT AMPLITUDE FATIGUE CRACK GROWTH IN ALUMINUM-LITHIUM SHEET AND PLATE
R. J. H. Wanhill, W. G. J. tHart, and L. Schra 24 Apr. 1991 43 p Presented at the 16th ICAF Symposium, Tokyo, Japan, May 1991 Previously announced in IAA as A93-13644 Sponsored by Netherlands Agency for Aerospace Programs
(NLR-TP-91104-U; ETN-92-92519) Avail: CASI HC A03/MF A01

Results of fatigue crack growth tests, performed to compare the modern Al-Li alloys 2090, 2091, and 8090 with the conventional damage tolerant alloys 2024 and 2324 are reviewed. These tests were done using constant amplitude and flight simulation loading. Under constant amplitude loading the Al-Li alloy crack growth behavior is often equivalent or superior to that of the conventional alloys. However, under gust spectrum loading the conventional alloys are generally better. The changes in rankings are explained from fracture surface analysis. The practical significance of the results is discussed, and guidelines for further investigation are given.
ESA

N93-17564# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.
MATHEMATICAL OPTIMIZATION: A POWERFUL TOOL FOR AIRCRAFT DESIGN
Otto Sensburg 28 Feb. 1992 22 p Presented at AGARD Lectures Series No. 186 on Integrated Design Analysis and Optimisation of Aircraft Structures Previously announced as N92-28474
(MBB-FE-2-S-PUB-478; ETN-92-92572) Copyright Avail: CASI HC A03/MF A01

Formal mathematical optimization methods developed during the past 10 to 15 years for the structural design of aircraft are considered. Together with reliable analysis programs like finite element methods they provide powerful tools for the structural design. They are efficient in at least two ways: producing designs that meet all specified requirements at minimum weight in one step; relieving the engineer from a time consuming search for modifications that give better results, they allow more creative design modifications. A powerful optimization code, called MBB-LAGRANGE, which uses mathematical programming and gradients to fulfill different constraints simultaneously, is considered. The application of this optimization program to the aeroelastic problems and structural design of a tailless sailplane is outlined. The enlargment of the optimization program to include also shape and size of airplanes is discussed. ESA

N93-17565# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.
PRACTICAL ARCHITECTURE OF DESIGN OPTIMISATION SOFTWARE FOR AIRCRAFT STRUCTURES TAKING THE MBB-LAGRANGE CODE AS AN EXAMPLE
J. Krammer 4 Mar. 1992 19 p Presented at AGARD Lecture Series No. 186 on Integrated Design Analysis and Optimisation of Aircraft Structures Previously announced as N92-28471
(MBB-FE-251-S-PUB-479; ETN-92-92575) Copyright Avail: CASI HC A03/MF A01

The solution of design tasks in the aircraft development process using structural optimization methods is presented. The structural optimization system MBB-LAGRANGE allows the optimization of homogeneous isotropic, orthotropic, or anisotropic structures. With the simultaneous consideration of different requirements in the design of aircraft structures it is possible to reduce the number of iteration steps between design, analysis, and manufacturing. Based on finite element methods for structures and panel methods for aerodynamics, the analysis with sensitivity includes modules for static, buckling, dynamic, static aeroelastic, and flutter calculations. The optimization algorithms consists of mathematical programming methods and an optimality criteria procedure. The important link between optimization and analysis/sensitivity is the optimization model which leads to a very modular architecture. Typical application examples show the power and generality of the approach. ESA

N93-17566# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
MODERN HELICOPTER TECHNOLOGIES AT MBB AND THE APPLICATION IN FUTURE PROGRAMMES
Werner Reinl 1991 22 p Presented at 17th European Rotorcraft Forum, Berlin, Germany, 24-27 Sep. 1991; sponsored by DGLR Previously announced in IAA as A92-56304
(MBB-UD-0599-91-PUB; ETN-92-92576) Avail: CASI HC A03/MF A01

The history of the German helicopter activities is described. A short definition of the market needs for the helicopter technologies, based on civil and military use is given, and current activities at MBB (Messerschmitt-Boelkow-Blohm) are described. The most important technology programs covering rotor technology, vibration supression, advanced composite airframes, avionics/cockpits and flight controls are presented. The present and future helicopter project like BO105, PAH2, NH90 and ALH are discussed. An outlook concerning MBB helicopter activities is given in conclusion. ESA

N93-17567# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Helicopter Div.
MISSION ORIENTED INVESTIGATION OF HANDLING QUALITIES THROUGH SIMULATION
Dieter Braun, Konstantin Kampa, and Dieter Schimke 1991 14 p Presented at 17th European Rotorcraft Forum, Berlin, Germany, 24-27 Sep. 1991; sponsored by DGLR Previously announced in IAA as A92-56353
(MBB-UD-0600-91-PUB; ETN-92-92577) Avail: CASI HC A03/MF A01

The methodology of simulation application in the design process of a helicopter is discussed. The simulation facility is described and the main features of the simulation model are explained. Special emphasis is laid on engine, landing gear, noise, and vibration modeling. The validation of the model was performed by use of trim values, time histories, derivatives, and frequency responses. A mission analysis is discussed using the example of an EMS mission. Exemplary investigations for the evaluation of mission effectiveness, control response behavior, and system failures are covered.
ESA

N93-17569# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Helicopter Div.
INFLUENCE OF CROSS SECTION VARIATIONS ON THE STRUCTURAL BEHAVIOUR OF COMPOSITE ROTOR BLADES
Helmut Rapp and Rudolf Woerndle 1991 11 p Presented at 17th European Rotorcraft Forum, Berlin, Germany, 24-27 Sep. 1991; sponsored by DGLR Previously announced in IAA as A92-56320
(MBB-UD-0602-91-PUB; ETN-92-92579) Avail: CASI HC A03/MF A01

Structural analysis of modern helicopter rotor blades with nonhomogeneous cross sections made from nonisotropic material is considered. It is noted that variations in cross section make this a highly complicated task. The analytical engineering theory of bending is addressed, however this analysis fails to describe all the necessary effects, such as restraint warping due to cross section variations, and restraint transverse deformation due to different Poisson ratios. The Finite Element Method (FEM), (with three dimensional solid elements), is addressed. This method is found to describe influences not described by the engineering theory of bending. However, the immense effort does not allow this method in general. Combinations of suited analytical methods with numerical FEM based methods allows a cost effective and sufficient accurate analysis of these complicated structures. Results of tests of the two methods are compared and show that in general the one dimensional engineering theory of bending combined with two dimensional theories for determining the cross section properties is sufficient to describe the structural blade behavior. Tests show a good coincidence with the theoretical results. ESA

N93-17571# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
TIGER DEVELOPMENT STATUS OVERVIEW
Klaus Schymanietz and Jerome Lebel (Aerospatiale, Marignane, France) 1991 11 p Presented at 17th European Rotorcracft Forum, Berlin, Germany, 24-27 Sep. 1991; sponsored by DGLR Previously announced

in IAA as A92-56305
(MBB-UD-0607-91-PUB; ETN-92-92582) Avail: CASI HC A03/MF A01

First prototype PT1, and PT1 flight test results are focused upon. Avionic system development activities are considered. The preliminary first flight test results show expected good results, as an example maximum speed of 170 kt reached just one month after first flight. Whereas the continuation of PT1 vehicle flight testing is going on in complete antitank configuration and later in HAP (French acronym for tactical support/protection helicopter) configuration the major importance is to be attached to the system activities. There the PT2 is in the process of finalization. Vehiclewise the final assembly works have started. Systemwise the avionic system integration tests started recently with some delay due to equipment availability. The PT2 will be ready for first flight after conduction of the sequence of final assembly activities including functional testings, safety visit by the officials and validation of the basic avionic system in the rig. A second prototype, PT3, will support the basic avionic flight testing in an antitank configuration. The mission equipment packages for HAP will be flight tested in PT4 and a retrofitted PT2, for HAC (French acronym for antitank helicopter) on a retrofitted PT3 and for PAH2 on PT5. ESA

N93-17660# Naval Postgraduate School, Monterey, CA.
STATISTICAL FATIGUE ANALYSIS OF THE SH-60B SERVO BEAM RAIL COMPONENT M.S. Thesis
Sally DeGozzaldi Sep. 1992 86 p
(AD-A257474) Avail: CASI HC A05/MF A01

Statistical methods were researched to better understand the effect of the flight loads on the servo beam rail component of the SH-60B helicopter. The extreme value distribution and the Weibull distribution were used to model the distribution of flight loads. Specifically, the flight loads for the symmetric pullout maneuver were studied. Both models successfully represented the data, although more data are required to be fully confident in these representations. Different flight characteristics indicate that various factors such as gross weight, airspeed, and collective position effect the distribution of loads. The model runs indicate a good representation of the individual runs in fatigue life calculations. The damage calculated for the Sikorsky substantiation load run was less conservative than the model run. In addition, the maximum load of the substantiation run was only in the 45th percentile of the load distribution estimated using an extreme value distribution for loads. The damage calculated for the Sikorsky substantiation load run was more conservative than the damage calculated for the individual runs which was reduced as much as 100 times when corrected for mean load. GRA

N93-17694# Naval Postgraduate School, Monterey, CA.
AN INVESTIGATION OF TWO-PROPELLER TILT WING V/STOL AIRCRAFT FLIGHT CHARACTERISTICS M.S. Thesis
William J. Nieusma, Jr. 1992 89 p
(AD-A257751) Avail: CASI HC A05/MF A01

The results of a two-propeller tilt wing aircraft static stability and performance simulation utilizing a NASA-Ames computer code, Tilt Wing Application General (TWANG), are presented with comparisons to actual test flight data. The Canadair CL-84 tilt wing aircraft was used as a model for the geometric data utilized by the computer simulation. Aerodynamic data for the simulation were obtained from previous NASA Ames research related to a four-propeller model. Variables used included a wide range of parameters associated with flight conditions from hovering flight to maximum cruise speeds at several different altitudes and wing tilt configurations. Longitudinal pitch stability was the driving factor in determining aircraft static stability for the various flight conditions. Results of the simulation indicate that the TWANG computer code provides an accurate prediction of both generic and specific tilt wing aircraft static pitch performance characteristics, as well as the additional capability of providing the required mathematical parameters for incorporation into the NASA Ames Vertical Motion Simulator as software inputs. GRA

N93-17711*# Purdue Univ., West Lafayette, IN. School of Aeronautics and Astronautics.
THE DESIGN OF A LONG RANGE MEGATRANSPORT AIRCRAFT Final Report, Aug. 1991 - Jun. 1992
Terrence A. Weisshaar and Carl L. Allen 30 Jun. 1992 17 p
(Contract NASw-4435)
(NASA-CR-192077; NAS 1.26:192077) Avail: CASI HC A03/MF A01

During the period from August 1991 - June 1992 two design classes at Purdue University participated in the design of a long range, high capacity transport aircraft, dubbed the megatransport. Thirteen Purdue design teams generated RFP's that defined passenger capability and range, based upon team perception of market needs and infrastructure constraints. Turbofan engines were designed by each group to power these aircraft. The design problem and the variety of solutions developed are described in an attached paper. Author

N93-17802*# Worcester Polytechnic Inst., MA.
NASA ADVANCED DESIGN PROGRAM: ANALYSIS, DESIGN, AND CONSTRUCTION OF A SOLAR POWERED AIRCRAFT B.S. Thesis
Agnes Chan, Kristin Conley, Christian T. Javorski, Kwok-Hung Cheung, Paul M. Crivelli, Nancy P. Torrey, and Michael L. Traver 1992 112 p
(Contract NASw-4435)
(NASA-CR-192040; NAS 1.26:192040) Avail: CASI HC A06/MF A02

Increase in energy demands coupled with rapid depletion of natural energy resources have deemed solar energy as the most logical alternative source of power. The major objective of this project was to build a solar powered remotely controlled aircraft to demonstrate the feasibility of solar energy as an effective, alternate source of power. The final design was optimized for minimum weight and maximum strength of the structure. These design constraints necessitated a carbon fiber composite structure. Surya is a lightweight, durable aircraft capable of achieving level flight powered entirely by solar cells. Author

N93-17803*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
EXODUS: PRIME MOVER Air transport system design simulation
Nikkol Bauer, Pete Conwell, Matt Johnson, Wendy Shields, Tim Thornton, Rob Tokarz, and Rich McManus May 1992 127 p Sponsored by NASA
(NASA-CR-192051; NAS 1.26:192051) Avail: CASI HC A07/MF A02

The Exodus Prime Mover is an overnight package delivery aircraft designed to serve the Northern Hemisphere of Aeroworld. The preliminary design goals originated from the desire to produce a large profit. The two main driving forces throughout the design process were first to reduce the construction man-hours by simplifying the aircraft design, thereby decreasing the total production cost of the aircraft. The second influential factor affecting the design was minimizing the fuel cost during cruise. The lowest fuel consumption occurs at a cruise velocity of 30 ft/s. Overall, it was necessary to balance the economic benefits with the performance characteristics in order to create a profitable product that meets all specified requirements and objectives. Author

N93-17804*# Ohio State Univ., Cleveland.
HYPERSONIC RECONNAISSANCE AIRCRAFT Scarlet 2 design team
Tim Bulk, David Chiarini, Kevin Hill, Bob Kunszt, Chris Odgen, and Bon Truong 1992 80 p Sponsored by NASA
(NASA-CR-192049; NAS 1.26:192049) Avail: CASI HC A05/MF A01

A conceptual design of a hypersonic reconnaissance aircraft for the U.S. Navy is discussed. After eighteen weeks of work, a waverider design powered by two augmented turbofans was chosen. The aircraft was designed to be based on an aircraft carrier and to cruise 6,000 nautical miles at Mach 4;80,000 feet and above. As a result the size of the aircraft was only allowed to have a length of eighty feet, fifty-two feet in wingspan, and roughly 2,300 square feet in planform area. Since this is a mainly cruise aircraft, sixty percent of its 100,000 pound take-off weight is JP fuel. At cruise, the highest temperature that it will encounter is roughly 1,100 F, which can be handled through the use of a passive cooling system. Author

N93-16761*# Hampton Univ., VA. Dept. of Mass Media Arts.
THE NASA HIGH-SPEED RESEARCH PROGRAM
Sherilee F. Beam *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 71-74
(For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16796*# Old Dominion Univ., Norfolk, VA.
MULTIDISCIPLINARY DESIGN OPTIMIZATION USING RESPONSE SURFACE ANALYSIS
Resit Unal *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 189-190 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17618# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Aircraft Div.
AERODYNAMIC ENGINE/AIRFRAME INTEGRATION FOR HIGH PERFORMANCE AIRCRAFT AND MISSILES
P. W. Sacher and W. Schmidt *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 21 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N93-16088# Mantech International Corp., Alexandria, VA. Support Technology.
PCB TESTER SELECTION FOR FUTURE SYSTEMS, VOLUME 1 Final Report, Aug. 1989 - Jun. 1991
William Schmitt Jun. 1992 83 p
(Contract F30602-89-C-0146)
(AD-A256256; RL-TR-92-162-Vol-1) Avail: CASI HC A05/MF A01

This report describes a computer program (to run on an IBM compatible PC) designed to aid in the selection of a PCB tester, given the characteristics of the PC board to be tested. The program contains a limited data base of PCB testers, and others may be added easily. This report also provides a specification for a limited family of PCB testers to fill the gap between what the U.S. Air Force is expected to need and what is expected to be available within the next four to six years. The parameters used in the computer program and the specification are based on a survey of military and commercial PCB's: both those now available and those expected to come on line within the next four to six years. The results of the survey are covered in volume 2 - available from DTIC. GRA

N93-16595# ManTech Support Technology, Inc., Alexandria, VA.
PCB TESTER SELECTION FOR FUTURE SYSTEMS, VOLUME 2 Final Report, Aug. 1989 - Jun. 1991
William Schmitt Jun. 1992 162 p
(Contract F30602-89-C-0146)
(AD-A256252; RL-TR-92-162-Vol-2) Avail: CASI HC A08/MF A02

This report describes a computer program (that runs on an IBM compatible PC) designed to aid in the selection of a PCB tester, given the characteristics of the PC board to be tested. The program contains a limited data base of PCB testers, and others may be added easily. This report also provides a specification for a limited family of PCB testers to fill the gap between what the U.S. Air Force is expected to need and what is expected to be available within the next four to six years. The parameters used in the computer program and the specification are based on a survey of military and commercial PCB's--both those now available and those expected to come on line within the next four to six years. The results of the survey are covered in volume 2--available from DTIC. GRA

N93-16693*# Boeing Commercial Airplane Co., Seattle, WA.
DEFINITION OF THE 2005 FLIGHT DECK ENVIRONMENT Final Report
K. W. Alter and D. M. Regal Washington Dec. 1992 108 p
(Contract NAS1-18027; RTOP 505-64-13-23)
(NASA-CR-4479; NAS 1.26:4479) Avail: CASI HC A06/MF A02

A detailed description of the functional requirements necessary to complete any normal commercial flight or to handle any plausible abnormal situation is provided. This analysis is enhanced with an examination of possible future developments and constraints in the areas of air traffic organization and flight deck technologies (including new devices and procedures) which may influence the design of 2005 flight decks. This study includes a discussion on the importance of a systematic approach to identifying and solving flight deck information management issues, and a description of how the present work can be utilized as part of this approach. While the intent of this study was to investigate issues surrounding information management in 2005-era supersonic commercial transports, this document may be applicable to any research endeavor related to future flight deck system design in either supersonic or subsonic airplane development. Author

N93-17547# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Avionic System Integration Dept.
TEST AND INTEGRATION CONCEPT FOR COMPLEX HELICOPTER AVIONIC SYSTEMS
Horst Goelzenleuchter and Lothar Dietl 1991 8 p Presented at 17th European Rotorcraft Forum, Berlin, Germany, 24-27 Sep. 1991; sponsored by DGLR Previously announced in IAA as A92-56292
(MBB-UD-0605-91-PUB; ETN-92-92581) Avail: CASI HC A02/MF A01

The stages in the development and integration of the TIGER basic avionic system are described. The most important integration tools for avionic integration purposes are described. These include an integrating rig for the installation and operation of the avionic equipment, patch panels which allow an access to all avionic signals, and a test system for complex measurements and tests. Besides the test system, various laboratory test equipment for direct signal stimulation for measurements are used. The tasks of the real time test system used for integration of the TIGER avionic system are described. These include the validation and monitoring of interface data flow, and simulation of environment/equipment data. The test system performance is considered. It is concluded that the test means for the TIGER basic avionic system offer the required flexibility for the integration of the various national versions of this helicopter at the same test rig. The use of an off the shelf test system avoids any development risks of a 'selfmade' solution. ESA

N93-17570# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Helicopter Div.
INTEGRATED HELMET SYSTEM TESTING FOR A NIGHTFLYING HELICOPTER
Hans-Dieter Boehm and Herbert Schreyer 1991 20 p Presented at 17th European Rotorcraft Forum, Berlin, Germany, 24-27 Sep. 1991; sponsored by DGLR Previously announced in IAA as A92-56291
(MBB-UD-0604-91-PUB; ETN-92-92580) Avail: CASI HC A03/MF A01

The requirements for and testing of an Integrated Helmet System (IHS) for helicopter application are presented. An IHS consists of a helmet shell, a Helmet Mounted Sight (HMS), two Image Intensifier Tubes (IIT) and two Cathode Ray Tubes (CRT) with an optical system including combiners to present the images binocular. Additional symbology can be superimposed to the CRT or IIT image. The HMS can steer a sensor platform with a thermal camera or an air to air missile system. The main helicopter requirements on such a system are: human factors; fit of helmet including optimized center of gravity and weight; optimized day, twilight and night optical modules; large exit pupil, good transmission of the optical path and a large adjustment range; good geometrical resolution/modulation transfer function with a large field of view; high focussing range of the IIT; CRT automatic brightness and contrast control with a good readability in day time; flight symbology presentation for one or two eyes; good static and dynamic HMS accuracy with a large head motion box; NBC (Nuclear, Biological, Chemical) and laser protection compatibility. The results of helicopter flight trials and laboratory tests showed there is no substitute for flight trials to completely understand an IHS for day and night flight capability. The difficult human engineering aspects have to be evaluated with functional IHS models to find the necessary improvements. ESA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N93-15979# Naval Postgraduate School, Monterey, CA.
STATIC PRESSURE MEASUREMENTS OF THE SHOCK-BOUNDARY LAYER INTERACTION IN A SIMULATED FAN PASSAGE M.S. Thesis
William L. Golden, Jr. Mar. 1992 136 p
(AD-A256724) Avail: CASI HC A07/MF A02

Two-dimensional experimental and numerical simulations of a transonic fan blade passage (M = 1.4) were conducted to provide baseline data for the study of the effects of vortex generating devices on shock-boundary layer interaction. A back pressure valve was designed for a transonic cascade blowdown wind tunnel, the test section was instrumented, and time-averaged static pressure distributions across the shock-boundary layer interaction were obtained. A numerical Navier-Stokes solution to the flow was also found. Sensitive and repeatable control of the cascade pressure ratio was demonstrated and the flow was shown to be reasonably two-dimensional across the span. GRA

N93-16080# Texas Univ., Austin. Turbulence and Turbine Cooling Research Lab.
HYDRODYNAMIC EFFECTS ON HEAT TRANSFER FOR FILM-COOLED TURBINE BLADES Final Report, Sep. 1988 - 30 Apr. 1992
David G. Bogard, Karen A. Thole, and Michael E. Crawford May 1992 115 p
(Contract F33615-88-C-2830)
(AD-A257291; WL-TR-92-2035) Avail: CASI HC A06/MF A02

The objectives were to develop a technique for generating very high freestream turbulence levels and to determine resulting effects on turbulent boundary layer and film cooling flows. Also, included was the development of a simultaneous temperature/velocity measurement technique. All of these objectives were accomplished as described below; however, film cooling flows were studied only for minimal freestream turbulence levels. Several turbulence generating devices were studied to determine the maximum turbulence levels. Tests indicated that high velocity jets in cross-flow generated turbulence levels, Tu, which ranged from Tu = 20 to 11 pct. over a 0.65 m distance. The turbulence integral length scales for this flow were on the order of boundary layer thickness. High freestream turbulence levels caused significant increases in surface heat flux. Various correlations for freestream turbulence affects on surface heat flux were evaluated. None of these correlations were adequate; however, with slight modifications two of the correlations reasonably collapsed the data. Thermal field measurements of simulated film cooling flows with a minimal freestream turbulence level indicated that the jet detachment/reattachment scaled with the momentum flux ratio. GRA

N93-16405# Aeronautical Research Labs., Melbourne (Australia).
A PRELIMINARY INVESTIGATION INTO THE FEASIBILITY OF USING A SMALL TURBOJET TO PROPEL AN EXPENDABLE HOVERING DECOY: PROPULSION TECHNICAL MEMORANDUM
P. Parmington Jun. 1992 27 p
(AD-A256320; ARL-PROP-TM-475; DODA-AR-006-677) Avail: CASI HC A03/MF A01

The use of a turbojet engine to propel a hovering decoy has been investigated to determine its suitability for this role in term of operating characteristics, vehicle/engine integration, and cost. The thrust and flight endurance were assumed to be 450 N and 5 minutes. As an alternative to purchasing engines from manufacturers, the option of manufacturing such an engine in Australia using off the shelf automotive turbocharger components has been explored. The special characteristics of the turbojet are compared with those of a rocket and some of the broader design considerations needed to adapt the turbojet to this application are discussed. GRA

N93-16705*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ACOUSTIC MODE MEASUREMENTS IN THE INLET OF A MODEL TURBOFAN USING A CONTINUOUSLY ROTATING RAKE
Laurence J. Heidelberg and David G. Hall (Sverdrup Technology, Inc., Brook Park, OH.) Dec. 1992 31 p Presented at the 31st Aerospace Sciences Meeting, Reno, NV, 11-14 Jan. 1993; sponsored by AIAA
(RTOP 535-03-10)
(NASA-TM-105989; E-7476; NAS 1.15:105989; AIAA Paper 93-0598)
Avail: CASI HC A03/MF A01

Comprehensive measurements of the spinning acoustic mode structure in the inlet of the Advanced Ducted Propeller (ADP) have been completed. These measurements were taken using a unique and previously untried method which was first proposed by T.G. Sofrin. A continuously rotating microphone system was employed. The ADP model was designed and built by Pratt & Whitney and tested in the NASA Lewis 9- by 15-foot Anechoic Wind Tunnel. Three inlet configurations were tested with cut-on and cutoff stator vane sets. The cutoff stator was designed to suppress all modes at the blade passing frequency. Rotating rake measurements indicate that several extraneous circumferential modes were active. The mode orders suggest that their source was an interaction between the rotor and small interruptions in the casing tip treatment. The cut-on stator produced the expected circumferential modes plus higher levels of the unexpected modes seen with the cutoff stator. Author

N93-16715*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TAKEOFF/APPROACH NOISE FOR A MODEL COUNTERROTATION PROPELLER WITH A FORWARD-SWEPT UPSTREAM ROTOR
Richard P. Woodward, David G. Hall (Sverdrup Technology, Inc., Brook Park, OH.), Gary G. Podboy, and Robert J. Jeracki Jan. 1993 23 p Presented at the 31st AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, 11-14 Jan. 1993; sponsored by AIAA
(RTOP 535-03-10)
(NASA-TM-105979; E-7479; NAS 1.15:105979; AIAA Paper 93-0596)
Avail: CASI HC A03/MF A01

A scale model of a counterrotating propeller with forward-swept blades in the forward rotor and aft-swept blades in the aft rotor (designated F39/A31) has been tested in the NASA Lewis 9- by 15-Foot Anechoic Wind Tunnel. This paper presents aeroacoustic results at a takeoff/approach condition of Mach 0.20. Laser Doppler velocimeter results taken in a plane between the two rotors are also included to quantify the interaction flow field. The intention of the forward-swept design is to reduce the magnitude of the forward rotor tip vortex and/or wakes which impinge on the aft rotor, thus lowering the interaction tone levels. A reference model propeller (designated F31/A31), having aft-swept blades in both rotors, was also tested. Aeroelastic performance of the F39/A31 propeller was disappointing. The forward rotor tip region tended to untwist toward higher effective blade angles under load. The forward rotor also exhibited steady state blade flutter at speeds and loadings well below the design condition. The noise results, based on sideline acoustic data, show that the interaction tone levels were up to 8 dB higher with the forward-swept design compared to those for the reference propeller at similar operating conditions, with these tone level differences extending down to lower propeller speeds where flutter did not occur. These acoustic results are for a poorly-performing forward-swept propeller. It is quite possible that a properly-designed forward-swept propeller would exhibit substantial interaction tone level reductions. Author

N93-16941*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A CRITICAL ANALYSIS OF THE ACCURACY OF SEVERAL NUMERICAL TECHNIQUES FOR COMBUSTION KINETIC RATE EQUATIONS
Krishnan Radhadrishnan Jan. 1993 62 p
(RTOP 505-31-42)
(NASA-TP-3315; E-5861; NAS 1.60:3315) Avail: CASI HC A04/MF A01

A detailed analysis of the accuracy of several techniques recently developed for integrating stiff ordinary differential equations is presented. The techniques include two general-purpose codes EPISODE and LSODE developed for an arbitrary system of ordinary differential equations, and three specialized codes CHEMEQ, CREK1D, and GCKP4 developed

specifically to solve chemical kinetic rate equations. The accuracy study is made by application of these codes to two practical combustion kinetics problems. Both problems describe adiabatic, homogeneous, gas-phase chemical reactions at constant pressure, and include all three combustion regimes: induction, heat release, and equilibration. To illustrate the error variation in the different combustion regimes the species are divided into three types (reactants, intermediates, and products), and error versus time plots are presented for each species type and the temperature. These plots show that CHEMEQ is the most accurate code during induction and early heat release. During late heat release and equilibration, however, the other codes are more accurate. A single global quantity, a mean integrated root-mean-square error, that measures the average error incurred in solving the complete problem is used to compare the accuracy of the codes. Among the codes examined, LSODE is the most accurate for solving chemical kinetics problems. It is also the most efficient code, in the sense that it requires the least computational work to attain a specified accuracy level. An important finding is that use of the algebraic enthalpy conservation equation to compute the temperature can be more accurate and efficient than integrating the temperature differential equation. Author

N93-17686# Naval Postgraduate School, Monterey, CA.
PRELIMINARY ANALYSIS OF THE J-52 AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAM M.S. Thesis
Randall S. Butler 1 Sep. 1992 104 p
(AD-A257640) Avail: CASI HC A06/MF A02

Increasing budgetary constraints have required program managers within the Naval Air Systems Command to justify their programs as never before. This thesis presents a preliminary analysis of the J-52 aircraft engine Component Improvement Program (CIP). The objectives of the research were to scrutinize the association of the CIP with promised improvements and benefits pertaining to the J-52 engine and to determine the obstacles that existing data bases present when an attempt is made to calculate the success or failure of a component modification. A history of the J-52 engine is provided along with a broad look at various engine performance parameter trends for the period 1984-1990. Ten Engineering Change Proposals (ECP's) are then examined. Analysis shows that while only one of the ten ECP related fixes can be directly correlated to a tangible increase in engine performance, the overall trends have been promising with regard to improving engine maintainability, reliability, and safety related factors. GRA

N93-17695# Naval Postgraduate School, Monterey, CA.
ANALYSIS OF CONSOLIDATION OF INTERMEDIATE LEVEL MAINTENANCE FOR ATLANTIC FLEET T700-GE-401 ENGINES M.S. Thesis
Jeffrey S. Cook Jun. 1992 128 p
(AD-A257754) Avail: CASI HC A07/MF A02

This thesis is an analysis of consolidation of duplicate capabilities for intermediate level maintenance of T700-GE-401 turboshaft engines belonging to Naval Air Force, Atlantic Fleet. The down-sizing of the military in the next decade and the resulting budget constrained reality will force the Navy to adopt innovative measures to save costs. One of the methods by which costs can be reduced is by combining the maintenance functions of activities with duplicated capabilities into one facility, as is proposed for the maintenance facilities for this engine. To test the feasibility of the consolidation concept, the thesis uses simulation to model an Aircraft Intermediate Maintenance Department (AIMD) operating as a consolidated T700 maintenance facility under a worst-case scenario. Based on the simulation results, the thesis concludes that the proposed consolidation is a viable concept. The thesis also uses life cycle cost analysis to quantify some of the cost savings resulting from the consolidation. Specific recommendations are then made regarding implementation of the consolidation concept. GRA

N93-17740# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
TURBOMACHINERY AND POTENTIAL COMPUTATIONS [TURBOMACHINES ET CALCULATEURS DE POTENTIEL]
J. M. Viguier, R. Krafft, and J. P. Mascarell 1991 18 p In FRENCH Presented at Journees de Printemps de la Societe Francaise de Metallurgie et de Materiaux Commission de Fatigue des Materiaux on 'Amorcage en Fatigue et Compteurs de Dommages', Paris, France, 28-29 May 1991
(DS-2026; ETN-93-93372) Copyright Avail: CASI HC A03/MF A01

A set of overhead projector graphics demonstrating means of calculating aerodynamic potential is presented. Calculation of lifetime and the thermodynamic, thermal mechanical damage, and remaining potential, of the jet engine, are considered. Calculation of potential is concluded to: avoid the risk of failure of vital parts; take into account the disparity between the real mission of each engine; optimize the maintenance logistics by real ageing knowledge; and reduce up keep costs through optimized maintenance. ESA

N93-17613# Centre National de la Recherche Scientifique, Paris (France). Ecole Centrale Paris.
COMBUSTION INSTABILITIES IN A SIDE-DUMP MODEL RAMJET COMBUSTOR
J. M. Samaniego, B. Yip, T. Poinsot, and S. Candel *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 17 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

N93-17615# Rheinmetall G.m.b.H., Duesseldorf (Germany).
RAMJET PROPULSION FOR ADVANCED PROJECTILES
R. Moenig and M. Moll *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 9 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A02/MF A03

N93-17616# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
COMPARISON OF PERFORMANCES OF DIFFERENT CIRCULAR INTAKES
Hermann L. Weinreich and Klaus Treisch (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Berlin, Germany) *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 8 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A02/MF A03

N93-17620# Microturbo, Toulouse (France).
SIMPLE AND POWERFUL TURBOJET WITH FOUR STAGE AXIAL COMPRESSOR AND AXIAL FLOW TURBINE FOR THE PROPULSION OF SUBSONIC MISSILES [TURBOREACTEUR SIMPLE ET PERFORMANT A COMPRESSOR AXIAL QUADRI-ETAGE ET TURBINE AXIALE POUR LA PROPULSION DE MISSILES SUBSONIQUES]
Jean-Paul Lopez and Charles Mischel *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 20 p In FRENCH (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

N93-17621# Sundstrand Turbomach, San Diego, CA. Aerothermo Conceptual Design.
SMALLER EXPENDABLE TURBOJETS
C. Rodgers *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 12 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

N93-17622# Centre d'Etudes et de Recherches, Toulouse (France).
PREDICTION OF THE PERFORMANCES IN COMBUSTION OF RAMJETS AND STATO-ROCKETS BY ISOTHERMAL EXPERIMENTS AND MODELING [PREDICTION DES PERFORMANCES EN COMBUSTION DE STATO-REACTEURS ET STATO-FUSEES PAR EXPERIMENTATIONS ISOTHERMES ET MODELISATIONS]
P. Hebrard, G. Lavergne, A. Torgue, F. Bismes, and G. Heid *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 9 p In FRENCH (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A02/MF A03

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N93-16009# Naval Air Warfare Center, Patuxent River, MD. Aircraft Div.
PITCH CONTROL MARGIN AT HIGH ANGLE OF ATTACK-QUANTITATIVE REQUIREMENTS (FLIGHT TEST CORRELATION WITH SIMULATION PREDICTIONS)
J. Lackey and C. Hadfield 1992 42 p
(AD-A257418) Avail: CASI HC A03/MF A01

Aircraft designs that employ relaxed static stability (RSS) have the following problem: reduced pitching moments associated with RSS at high angle of attack (AOA) require a minimum pitch recovery moment or margin to guarantee a safe return from high AOA maneuvers at the most aft center of gravity (CG) encountered during a mission. Recent incidents and mishaps on Class IV aircraft have demonstrated a need for establishing quantitative longitudinal high AOA pitch control margin design guidelines for future aircraft. The Naval Air Warfare Center - Aircraft Division (NAWC-AD) is currently supporting an effort in conjunction with NASA Langley Research Center (NASA LARC) to quantify such requirements. NASA LaRC has conducted a series of extensive simulation evaluations to define these design guidelines. GRA

N93-16036# Systems Technology, Inc., Hawthorne, CA.
APPLICATION OF AN ADAPTIVE CLUSTERING NETWORK TO FLIGHT CONTROL OF A FIGHTER AIRCRAFT, PHASE 1 Final Report
James C. Smith, Robert V. Walters (STR Corp., Reston, VA.), Henry R. Jex, and Bimal L. Aponso 19 Dec. 1991 77 p
(Contract N62269-91-C-0206)
(AD-A253388; STI-TR-1285-1-Phase-1; NADC-91123-60-Phase-1) Avail: CASI HC A05/MF A01

An artificial neural net controller was developed for a typical fighter aircraft's longitudinal Stability and Control Augmentation System (SCAS), using elevator and thrust-vector-angle controls, and operating at high angle of attack. The 'baseline' neurocontroller (NC) was in the feedforward loop (Kawato Type-C), with inputs from the pilot's pitch rate commands and rates and SCAS feedback error. An Adaptive Clustering Network algorithm was used to train the radial-basis-function neurons. Significant improvements in performance resulted from the NC action and these effects were analyzed by frequency domain describing functions. Thrust vector failures were handled satisfactorily, but reconfiguration of the SCAS was not possible within the simplified aircraft and NC effects. Phase 2 recommendations are included, such as ways to choose signals for the neural net to more efficiently identify and separate failures of correlated control effectors; the further use of frequency domain describing functions to identity neurocontroller dynamic processes; and the development of a Neuro-controller Analysis Toolbox with diagnostic forcing functions, methods, analyses, and benchmark criteria for evaluation to a common NC standard. GRA

N93-16067# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
COMPARATIVE ANALYSIS OF GUIDANCE ALGORITHMS FOR THE HYPER VELOCITY MISSILE AND AFTI/F-16 Final Report
Edward G. Rice 12 Nov. 1991 129 p
(AD-A256728; AFIT/GE/ENG/92M-02) Avail: CASI HC A07/MF A02

This project has provided me with endless intrigue. In considering the problem of guiding a hypervelocity missile from a moving platform to a moving target, a common perception said it was just another Kalman Filtration design challenge. I began with lofty intentions of running a full up extended Kalman filter simulation but I became enthralled with the limited work available on the physical limitations of basic guidance algorithms. This became the emphasis of this project. The best filter scheme cannot overcome a guidance algorithms physical limitation. Only with an understanding of these limitations can one effectively integrate a guidance scheme with a Kalman filter. This effort is an exploration of these physical lits for four common guidance algorithms proposed for the HVM. My most untimely PCS to Griffiss AFB, and away from the AFIT resources, forced the construction of an Extended Kalman Filter and the full error sensitivity analysis to be a recommended future effort. GRA

N93-16165# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
MULTIPLE MODEL ADAPTIVE ESTIMATION APPLIED TO THE VISTA F-16 WITH ACTUATOR AND SENSOR FAILURES, VOLUME 2 Final Report
Timothy E. Menke 1 Jun. 1992 244 p
(AD-A256569; AFIT/GA/ENG/92J-01-Vol-2) Avail: CASI HC A11/MF A03

A Multiple Model Adaptive Estimation (MMAE) algorithm is applied to the Variable Stability In-flight Simulator Test Aircraft (VISTA) F-16 at a low dynamic pressure flight condition (0.4 Mach at 20000 ft). A complete F-16 flight control system is modeled containing the longitudinal and lateral-directional axes. Single and dual actuator and sensor failures are simulated including: complete actuator failures, partial actuator failures, complete sensor failures, increased sensor noise, sensor biases, dual complete actuator failures, dual complete sensor failures, and combinations of actuator and sensor failures. Failure scenarios are examined in both maneuvering and straight and level flight conditions. The system performance is characterized when excited by purposeful commands and dither signals. Single scalar residual monitoring techniques are evaluated with suggestions for improved performance. A Kahnan filter is designed for each hypothesized failure condition. In this thesis, thirteen elemental Kalman filters are designed encompassing: a no failure filter, left stabilator failure filter, a right stabilator failure filter, a left flaperon failure filter, a right flaperon failure filter, a rudder failure filter, a velocity sensor failure filter, an angle of attack sensor failure filter, a pitch rate sensor failure filter, a normal acceleration sensor failure filter, a roll rate sensor failure filter, a yaw rate sensor failure filter, and a lateral acceleration sensor failure filter. GRA

N93-16463 Department of the Navy, Washington, DC.
ARTICULATED CONTROL SURFACE Patent
Manuel Cincotta, inventor (to Navy) and Richard H. Nadolink, inventor (to Navy) 19 May 1992 6 p Filed 1 Oct. 1990
(AD-D015464; US-Patent-5,114,104; US-Patent-Appl-SN-591532; US-Patent-CLass-244-219) Avail: US Patent and Trademark Office

An articulated control surface for flight control utilizes a moldable control surface that is shaped by contracting and elongating shape memory alloys embedded within the control surface. The shape memory alloys contract when heated via an applied electric current and elongate when cooled, i.e., the electric current is removed. The resulting control surface is capable of generating a curved control surface without any electro/mechanical or hydraulic control systems. GRA

N93-16560*# Toledo Univ., OH. Dept. of Mechanical Engineering.
AEROELASTIC STABILITY AND RESPONSE OF ROTATING STRUCTURES Final Technical Report
Theo G. Keith, Jr. Jan. 1993 7 p
(Grant NsG-3139)
(NASA-CR-191803; NAS 1.26:191803) Avail: CASI HC A02/MF A01

A summary of the work performed during the progress period is presented. Analysis methods for predicting loads and instabilities of wind turbines were developed. Three new areas of research to aid the Advanced Turboprop Project (ATP) were initiated and developed. These three areas of research are aeroelastic analysis methods for cascades including blade and disk flexibility; stall flutter analysis; and computational aeroelasticity. L.R.R.

N93-16618# Technische Univ., Munich (Germany). Dept. of Mathematics.
COMBINING DIRECT AND INDIRECT METHODS IN OPTIMAL CONTROL: RANGE MAXIMIZATION OF A HANG GLIDER
R. Bulirsch, E. Nerz, H. J. Pesch, and O. vonStryk 1991 25 p
(Rept-313) Avail: CASI HC A03/MF A01

When solving optimal control problems, indirect methods such as multiple shooting suffer from difficulties in finding an appropriate initial guess for the adjoint variables. This initial estimate must be provided for the iterative solution of the multipoint boundary-value problems arising from the necessary conditions of optimal control theory. Direct methods such as direct collocation do not suffer from this problem, but they generally yield results of lower accuracy, and, what may be disasterous, their iteration may even terminate

with a non-optimal solution. Therefore, both methods are combined in such a way that the direct collocation method is at first applied to a simplified optimal control problem where all inequality constraints are neglected as long as the resulting problem is still well-defined. Because of the larger domain of convergence of the direct method, an approximation of the optimal solution of this problem can be obtained more easily. The fusion between direct and indirect methods is then based on a relationship between the Lagrange multipliers of the underlying nonlinear programming problem to be solved by the direct method and the adjoint variables appearing in the necessary conditions which form the boundary-value problem to be solved by the indirect method. Hence, the adjoint variables, too, can be estimated from the approximation obtained by the direct method. This first step then facilitates the subsequent extension and completion of the model by homotopy techniques and the solution of the arising boundary-value problems by the indirect multiple shooting method. The high accuracy and reliability of the multiple shooting method, especially the precise computation of the switching structure and the possibility to verify many necessary conditions, is preserved while disadvantages caused by the sensitive dependence on an appropriate estimate of the solution are considerably cut down. This procedure is described in detail for the numerical solution of the maximum-range trajectory optimization problem of a hang glider in an upwind which provides an example for a control problem where appropriate initial estimates for the adjoint variables are hard to find. Author

N93-17670# Naval Postgraduate School, Monterey, CA.
DESIGN OF ROBUST SUBOPTIMAL CONTROLLERS FOR A GENERALIZED QUADRATIC CRITERION M.S. Thesis
Kurtis B. Miller Jun. 1992 66 p
(AD-A257746) Avail: CASI HC A04/MF A01

Standard linear quadratic regulator (LQR) designs guarantee a certain level of robustness. However, optimizing a generalized quadratic criterion produces coupled state and input terms and there are no longer any guarantees of good robustness properties. This thesis identifies how this problem arises and then presents several suboptimal, but robust controller design options which provide the control systems engineer with the ability to perform a trade-off between performance and robustness. The effectiveness of these methods is investigated and the trade-offs between performance and robustness are evaluated using computer simulation of a statically unstable fighter aircraft. GRA

N93-17800*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
LOW BANDWIDTH ROBUST CONTROLLERS FOR FLIGHT Final Report, Jun. 1991 - Dec. 1992
Daniel J. Biezad and Hwei-Lan Chou 1992 50 p
(Contract NCC2-711)
(NASA-CR-191774; NAS 1.26:191774) Avail: CASI HC A03/MF A01

During the final reporting period (Jun. - Dec. 1992), analyses of the longitudinal and lateral flying qualities were made for propulsive-only flight control (POFC) of a Boeing 720 aircraft model. Performance resulting from compensators developed using Quantitative Feedback Theory (QFT) is documented and analyzed. This report is a first draft of a thesis to be presented by graduate student Hwei-Lan Chou. The final thesis will be presented to NASA when it is completed later this year. The latest landing metrics related to bandwidth criteria and based on the Neal-Smith approach to flying qualities prediction were used in developing performance criteria for the controllers. The compensator designs were tested on the NASA simulator and exhibited adequate performance for piloted flight. There was no significant impact of QFT on performance of the propulsive-only flight controllers in either the longitudinal or lateral modes of flight. This was attributed to the physical limits of thrust available and the engine rate of response, both of whiih severely limited the available bandwidth of the closed-loop system. Author

N93-16769*# Michigan State Univ., East Lansing. Dept. of Mechanical Engineering.
DEVELOPING A CONTROL SYSTEM FOR ARES 2
Philip M. FitzSimons *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 106-109 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17617# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
MULTIPLE-INLET CONFIGURATION FOR MISSILES WITH SKID-TO-TURN CONTROL MODE
W.-D. Pohl and E.-O. Krohn (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Berlin, Germany) *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 13 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N93-15790*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TECHNOLOGY BENEFITS AND GROUND TEST FACILITIES FOR HIGH-SPEED CIVIL TRANSPORT DEVELOPMENT
Matthew M. Winston, Elwood M. Shields (Lockheed Engineering and Sciences Co., Hampton, VA.), and Shelby J. Morris, Jr. Dec. 1992 29 p
(RTOP 505-69-20-01)
(NASA-TM-107670; NAS 1.15:107670) Avail: CASI HC A03/MF A01

The advanced technology base necessary for successful twenty-first century High-Speed Civil Transport (HSCT) aircraft will require extensive ground testing in aerodynamics, propulsion, acoustics, structures, materials, and other disciplines. This paper analyzes the benefits of advanced technology application to HSCT concepts, addresses the adequacy of existing groundbased test facilities, and explores the need for new facilities required to support HSCT development. A substantial amount of HSCT-related ground testing can be accomplished in existing facilities. The HSCT development effort could also benefit significantly from some new facilities initially conceived for testing in other aeronautical research areas. A new structures testing facility is identified as critically needed to insure timely technology maturation. Author

N93-15998# Federal Aviation Administration, Washington, DC. Systems Research and Development Service.
UNIFIED AIRPORT PAVEMENT DESIGN AND ANALYSIS CONCEPTS WORKSHOPS
Jul. 1992 579 p Workshops held in Cambridge, MA, 16-17 Jul. 1991
(AD-A257157; DOT/FAA/RD-92/17) Avail: CASI HC A25/MF A06

This publication outlines the proceedings of a workshop held in July 1991 at Cambridge, MA. The workshop provided a forum for leading pavement engineers, researchers and materials scientists to present concepts for the formulation of a unified mechanistic methodology for the analysis and design of pavements serving civil aircraft. The need developed from industry's requests for adequate methods to design, analyze and predict performance of pavements serving more demanding aircraft. The publication contains essential elements of papers and reports presented at the workshop. The general agreement was that, given the prevailing state of the art in computer capability, the requirements for increased capacity through more frequent passes and heavier aircraft, and the development of new man-made construction materials, a more realistic and cost-beneficial approach to pavement analysis and design could be accomplished through the use of discrete material elements, faithful representation of actual material behavior and geometry, and dynamic interaction with rates of loading from any gear configuration. The belief was that computer programs capable to perform the task already exist in other areas of engineering mechanics and that they could be tailored for pavement applications. The papers presented would substitute current methods based on empirical data and broad theoretical assumptions with a generally applicable mechanistic approach. The suggested approach would obviate anomalies that result when current methods are applied to certain cross-section configurations. GRA

N93-16309# Federal Aviation Administration, Washington, DC.
UNIFIED AIRPORT DESIGN AND ANALYSIS CONCEPTS WORKSHOP
Jul. 1992 542 p Workshop held in Cambridge, MA sponsored by the

Federal Aviation Administration 16-17 Jul. 1991 Original contains color illustrations
(Grant GWA 89-TA)
(DOT/FAA/RD-92/17) Avail: CASI HC A23/MF A04; 9 functional color pages

The proceedings of a workshop held in July 1991 at Cambridge, MA are outlined. The workshop provided a forum for leading pavement engineers, researchers, and materials scientists to present concepts for the formulation of a unified mechanistic methodology for the analysis and design of pavements serving civil aircraft. The need developed from industry's requests for adequate methods to design, analyze, and predict performance of pavements serving more demanding aircraft. Essential elements of papers and reports presented at the workshop are included. For individual titles, see N93-16310 through N93-16319.

N93-16310# Arizona State Univ., Flagstaff. Dept. of Civil Engineering.
STATE OF THE ART OF AIRPORT PAVEMENT ANALYSIS AND DESIGN

J. Zaniewski *In its* Unified Airport Pavement Design and Analysis Concepts Workshop Jul. 1992 p 1-51 (For primary document see N93-16309 05-09)
Avail: CASI HC A03/MF A04; 9 functional color pages

Due to the difficulty of the airport pavement analysis process, design methods have evolved in an empirical manner. While these methods produced workable designs, they have several shortcomings. There have been significant developments in the areas of engineering mechanics and materials evaluation that can provide the foundation for the development of improved airport pavement design procedures. The purpose of this report is to summarize the state of the art in airport pavement analysis models. This task does not have a clear boundary. There are models that have been used for many years for pavement design. There are also models that are applied only by engineers that are on the leading edge of technology for the design of pavement structures. Other models have been proposed by researchers but have not been used extensively for airport pavement analysis. Finally, there are models that have been developed in other engineering fields that can be applied to the analysis of airport pavements. Author

N93-16311# Illinois Univ., Urbana.
DEVELOPMENT OF USER GUIDELINES FOR A THREE-DIMENSIONAL FINITE ELEMENT PAVEMENT MODEL

A. M. Ioannides and J. P. Donnelly (Wiss, Janney, Elstner and Associates, Inc., Northbrook, IL.) *In its* Unified Airport Pavement Design and Analysis Concepts Workshop Jul. 1992 p 52-85 (For primary document see N93-16309 05-09)
Avail: CASI HC A03/MF A04; 9 functional color pages

A multi-component project, sponsored by the U.S. Air Force Office of Scientific Research (AFOSR), has recently examined current computerized analysis techniques for slabs-on-grade. The final stage of those investigations involved the use of an existing three-dimensional finite element model, which was adapted to provide a more realistic representation of a pavement system. One of the conclusions of that study was that a three-dimensional finite element program will be 'indispensible in future efforts to establish the elusive 'unified' approach (to pavement design) and to develop a generalized mechanistic design procedure.' The Federal Aviation Administration (FAA) initiative for the development of a 'Unified Pavement Theory' has provided new impetus for considering the three-dimensional finite element approach and has renewed interest in studies for the development of user guidelines for this sophisticated technique. The results of more than 100 three-dimensional finite element runs conducted to develop such user guidelines during the aforementioned AFOSR study are reported in detail. Research is reported of the slab-on-grade problem. Findings presented provide an essential guide for the effective utilization of the three-dimensional finite element approach, and are described herein to facilitate development efforts under the FAA initiative, and perhaps eliminate the need for conducting such preliminary and time-consuming studies again. Author

N93-16312# Texas A&M Univ., College Station.
MICRO MECHANICAL BEHAVIOR OF PAVEMENTS

R. Lytton *In its* Unified Airport Pavement Design and Analysis Concepts Workshop Jul. 1992 p 86-123 (For primary document see N93-16309 05-09)
Avail: CASI HC A03/MF A04; 9 functional color pages

A brief summary of the types of distress, the types of material properties, and which types of material properties are needed to describe each type of distress in each airport pavement layer are presented. Constitutive equations that are appropriate for these material properties are listed in increasing order of complexity, with the simpler ones being preferred for microcomputer applications. Illustrations of materials characterizations are presented covering a simple way of representing the damage done to a material by microcracking, the formulation of elastic dilatancy, and the determination of material properties for a hypoelastic base course material. These illustrations demonstrate the kind of materials characterization that will be required to permit accurate predictions of the rate of appearance of pavement distress and FOD potential. It is envisioned that all of these materials characterizations will be implemented in a three-dimensional (3-D) finite element (FE) program and thus the materials properties must have two principal attributes: (1) they must be capable of being determined from laboratory tests, and (2) they must be capable of being represented in a finite element program and lead to stable convergence in an iterative computational scheme. Author

N93-16313# Pennsylvania State Univ., University Park.
THERMOVISCOELASTIC ANALYSIS OF PAVEMENTS

S. K. Reddy and M. G. Sharma *In its* Unified Airport Pavement Design and Analysis Concepts Workshop Jul. 1992 p 124-168 (For primary document see N93-16309 05-09)
Avail: CASI HC A03/MF A04; 9 functional color pages

In design and rehabilitation of pavements, it is necessary to evaluate damage due to traffic loading and environmental conditions. Damage in multilayered asphalt pavements could be of various types, namely transverse and longitudinal cracking, delamination, rutting, and degradation of material properties. Computation of stresses and strains is essential for the evaluation of damage. Analysis of stresses due to the effect of temperature was considered. The stresses in the surface layer could be severe, as it is subjected to a wider range of temperatures compared to the underlying layers. Also, since the asphaltic top layer is a rheological material, the stresses are functions of both loading and time. These stresses could cause damage due to cracking, especially at low temperatures during winter or due to thermal fatigue as the pavement is subjected to cyclic variation of temperature. Also, delamination can occur due to the multilayered nature of pavements and the resulting mismatch in thermal properties of adjacent layers. Since pavements are layered systems, the temperature variations give rise to complex stresses in the system which can be evaluated only through numerical methods such as finite element analysis. Although a three-dimensional analysis is desirable, it is complex and time consuming. Hence, as a primary step, two-dimensional analyses with and without temperature gradients was performed in the investigation. In addition, the effect of physical hardening of asphalt layer on thermal stress was evaluated. Author

N93-16314# Foster-Miller Associates, Inc., Waltham, MA.
FAA UNIFIED PAVEMENT ANALYSIS 3-D FINITE ELEMENT METHOD

S. J. Kokkins *In its* Unified Airport Pavement Design and Analysis Concepts Workshop Jul. 1992 p 169-232 (For primary document see N93-16309 05-09)
Avail: CASI HC A04/MF A04; 9 functional color pages

The limitations of the existing pavement analysis and design methods do not yet provide a model capable of accurately predicting the useful life of airport pavements. This includes the prediction of pavement performance in terms of distress as a function of traffic and environmental loadings, and their mutual interaction. The eventual model must be sensitive to the initial material properties and must respond to the daily, seasonal, and aging variations in these properties. Primarily, the unified theory must provide the theoretical foundation for the prediction of pavement displacement and deflection basin profile under different types of aircraft as well as under different types of nondestructive testing devices. The pavement evaluation methodology should include the ability to determine pavement properties from the results of nondestructive testing. This program demonstrates that 3-D finite element (FE) structural modeling is an effective and practical method for evaluating the response of airport pavement systems, and that it can form the basis of the unified pavement analysis method. Although

the work so far has used existing analytical tools, similar methods tailored to the needs of airport pavements, together with appropriate constitutive material relationships and modern computer graphics can be integrated into a unified pavement analysis system using 3-D FE modeling. Accomplishments, described in this report, include (1) demonstration and verification of the solution of classical pavement problems using 3-D FE analysis; (2) formulation and solution of a range of practical aircraft load and airport pavement configurations, showing the capabilities of these methods; (3) visualization of the results using 3-D color graphics; (4) evaluation of two forms of nonlinear soil response; and (5) developments in the constitutive material modeling relationships for pavement materials, suitable for inclusion in FE solution procedures. Author

N93-16315# Battelle Columbus Labs., OH.
FEDERAL AVIATION ADMINISTRATION PAVEMENT MODELING
T. Forte, K. Majizadeh, J. Kennedy, J. Hadden, T. White, Andrew Sluz, and Aston McLaughlin *In its* Unified Airport Pavement Design and Analysis Concepts Workshop Jul. 1992 p 233-313 Original contains color illustrations (For primary document see N93-16309 05-09)
Avail: CASI HC A05/MF A04; 9 functional color pages

The Federal Aviation Administration (FAA) of the U.S. Department of Transportation (DOT) has recognized the significant limitations of current pavement design and analysis techniques. As a result, the FAA has initiated a multi-year program to develop a model capable of predicting accurately the useful life of airport pavements. This model, a Unified Pavement Design and Analysis Program (UPDAP), will be capable of predicting stresses, deformations, and performance in any airport pavement system for nearly any pavement configuration, material, and operating/environmental condition. It will be based on mechanistic principles, rather than on empirically derived relationships, and will provide pavement engineers with a comprehensive, flexible analytical tool for efficient design or evaluation of new and existing pavements. For existing pavements, the UPDAP will be capable of integrating inspection data to establish the current state of the pavement, and to assess proposed rehabilitation actions. The scope of the task was the development and justification of a concept for the UPDAP. It includes a recommended concept for the UPDAP, an in-depth presentation of a recommended methodology for pavement constitutive modeling, recommendations for pavement structural modeling, damage modeling considerations, a discussion of the critical issues associated with field testing of pavement systems, and conclusions and recommendations for further study. Author

N93-16316# Resource International, Inc., Columbus, OH.
STATE OF THE ART REVIEW OF RUTTING AND CRACKING INPAVEMENTS
K. Majidzadeh (Ohio State Univ., Columbus.), C. L. Saraf, S. Mesarovic, and G. J. Ilves *In its* Unified Airport Pavement Design and Analysis Concepts Workshop Jul. 1992 p 314-391 (For primary document see N93-16309 05-09)
Avail: CASI HC A05/MF A04; 9 functional color pages

Several available computer methods and models to predict pavement rutting are reviewed. All these programs were originally developed for highway pavement distress prediction and/or analysis. Thus, some modifications will be needed considering the substantially higher tire pressures and wheel loads to be expected from aircraft. Careful considerations of asphalt concrete rutting prediction models is necessary in view of the inherently high tire pressures (over 300 psi) (2 MPa) applied by some aircraft. It is estimated that plastic yield of asphalt concrete occurs at this high pressure which is well above the threshold pressure used for permanent deformation characterization of asphalt concrete mixtures for highway applications. Several rutting models based on empirical relationships are discussed. Fracture mechanics can be used to analyze cracking in pavements. The discussion on fracture mechanics is divided into the following topics: (1) application of fracture mechanics to pavement materials; (2) application of fracture mechanics to analyze pavements; (3) effect of mix variables on the fatigue parameters; (4) extension of cracking analysis to include non-linear behavior of materials; and (5) considerations for the statistical nature of the pavement system and its components. Author

N93-16317# ERES Consultants, Inc., Savoy, IL.
DEVELOPMENT OF A UNIFIED AIRPORT PAVEMENT ANALYSIS AND DESIGN SYSTEM
E. Owusu-Antwi, M. G. Sharma (Pennsylvania State Univ., University Park.), R. H. Dodds (Illinois Univ. at Urbana-Champaign, Savoy.), P. D. Hilton (Little, Arthur D., Inc., Cambridge, MA), M. I. Darter (Illinois Univ. at Urbana-Champaign, Savoy.), and H. T. Yu (Little, Arthur D., Inc., Cambridge, MA) *In its* Unified Airport Pavement Design and Analysis Concepts Workshop Jul. 1992 p 392-445 (For primary document see N93-16309 05-09)
Avail: CASI HC A03/MF A04; 9 functional color pages

Aircraft weight and number of operations at our nation's airports are expected to continue to increase into the foreseeable future. This will place a heavy burden on the pavement facilities at U.S. airports, which if not adequately designed, will result in significant deterioration. To insure that airport pavement facilities will be capable of carrying these increased traffic levels, the Federal Aviation Administration (FAA), through the Volpe National Transportation System Center (TSC), is sponsoring research on the development of a unified pavement model for the analysis and design of airport pavements. The goal of this program is to make the technological leap that will allow a more reliable analysis and design of all types of airport pavements, since current design procedures have many serious deficiencies. This paper describes the concepts proposed for the development of such a unified airport pavement analysis and design system. The central component of the system is a 3-dimensional finite element analysis (FEA) based primary response model, applicable to the nonlinear analysis of all types of airport pavements. A unique solution procedure is proposed that will allow the realistic solution of complex airport problems on desktop computers. This procedure is expected to reduce memory requirements and increase processing speed by a factor of between 5 and 10, in comparison to currently available 3-dimensional codes, and thus reduce computation costs. Another major portion of the proposed system is the material constitutive models proposed for incorporation in the primary response model. Incremental constitutive models for the major classes of airport pavement materials, that will allow a stepwise addition of 'memory' variables or parameters to basic constitutive models to accurately describe the physical behavior of increasing complex materials, will be incorporated into the primary response model. A database of the outputs of nodal displacements, stresses, strains, and local damage measures generated by the primary response model will be used in a damage analysis, the results of which can be used to predict key distress types. This will provide for greater design reliability and cost-effective pavement design. Author

N93-16318# SRI International Corp., Menlo Park, CA.
UNIFIED AIRPORT PAVEMENT DESIGN PROCEDURE
L. Seaman, J. W. Simons, D. A. Shockey, R. F. Carmichael, III (ARE, Inc., Austin, TX.), and B. F. McCullough (ARE, Inc., Austin, TX.) *In its* Unified Airport Pavement Design and Analysis Concepts Workshop Jul. 1992 p 446-537 Original contains color illustrations (For primary document see N93-16309 05-09)
Avail: CASI HC A05/MF A04; 9 functional color pages

Initial steps were taken toward developing a mechanistic approach to the design of airport pavement structures and carried through sufficiently to provide proof of concept. At the start of this project, the major elements that were unavailable were determined to be a method for lifetime prediction and material models to describe fatigue cracking and rutting. During this project, we have developed initial versions of all three of these elements. We have developed a method for predicting pavement lifetimes using three-dimensional finite element codes and the material models. This prediction procedure led us to requirements on the nature and accuracy of the material models. The material model for fatigue cracking is a micromechanical extension of an available fatigue model used for metals and other materials. This mechanistic model is based on the presence of flaws in the material that are grown during periods of tensile stress. With sufficient growth, these flaws become the large cracks that represent destruction of both Portland cement and asphalt concrete pavement. The fatigue model was incorporated into an SRI multiple-plane plasticity model to be able to represent the serious anisotropy that develops during cracking. This combined model, in a computer subroutine, was included with the three-dimensional finite element code DYNA3D, and simulations were made for an aircraft wheel gear rolling over a pavement. Then a lifetime prediction was made based on fatigue cracking in the base of the pavement. The rutting model was developed based on an examination of the observed (and unusual) viscoelastic, dilatant, and viscoplastic behavior of asphalt

concrete pavement. The model has components that represent each of these aspects, although rutting probably depends primarily on the permanent deformation caused by the viscoplastic behavior. The model appears to reproduce laboratory data satisfactorily. We have not completed implementation of the model into a computer subroutine appropriate for combining with DYNA3D, so we could not perform simulations of wheel loading tests. Through this project we have developed a lifetime prediction procedure, a material model for fatigue damage, and a model for rutting. We have shown that each appears to represent field and/or laboratory conditions, although we do not have complete quantitative verifications. However, we feel that we have shown that each of these major new aspects of the pavement design procedure is feasible. Because the concept of a unified pavement theory has been proved in this initial project, we recommend continuation of the effort to develop a mechanistic design procedure for pavements. Author

N93-16319# Department of Transportation, Cambridge, MA.
THREE-DIMENSIONAL STRESS ANALYSIS OF MULTILAYERED AIRPORT PAVEMENTS: INTEGRAL TRANSFORM APPROACH
G. Samavedam *In its* Unified Airport Pavement Design and Analysis Concepts Workshop Jul. 1992 p 538-565 (For primary document see N93-16309 05-09)
Avail: CASI HC A03/MF A04; 9 functional color pages

With the increased traffic of current aircraft and larger and heavier aircraft likely to be introduced in the near future, the performance demands on existing airport pavements will be significantly higher than those envisioned a few decades ago. The maintenance and repair of the existing pavements and potential new designs in the future must take full advantage of advanced theories on the subject. At present, several advanced concepts are available in the general field of structural mechanics which are not fully exploited for the pavement analysis. There are several reasons for the current state of art in the pavement being not on a part with modern developments in structural mechanics. One of the reasons is that the airport pavement structures were there long before the advanced computer models/concepts emerged. A large amount of work had already been expended in testing and empirical correlations of the test data. A primary reason, however, is due to the fact that no systematic investigations have been carried out on the validity and applicability of the advanced structural mechanics concepts to the pavement structure. Such investigations form a major part of the research being initiated by Volpe National Transportation Systems Center/Federal Aviation Administration (VNTSC/FAA), with the ultimate aim of synthesizing into an advanced unified treatment of all types of pavements. This report presents ideal characteristics of the structural and material modeling for pavement and deals specifically in an approach for three-dimensional stress analysis of the pavement structure. Author

N93-16468# Manchester Univ. (England). Aeronautical Engineering Group.
DESIGN OF A NOZZLE FOR A HYPERSONIC WIND TUNNEL
A. H. Tajfar and I. M. Hall 1991 98 p
(Aero-Rept-9113; ETN-92-92779) Avail: CASI HC A05/MF A02

The design of two dimensional wind tunnel nozzles, with test section Mach numbers up to Mach 10, for supersonic and hypersonic testing is described. The design starts with the transonic region, the throat section, using previously obtained solutions. The method of characteristics was used for the design of the supersonic part of the nozzle. In the supersonic part, a smooth Mach number distribution was specified along the axis of symmetry. Using a cubic variation ensured smooth acceleration was successful for low supersonic Mach numbers, however it failed to produce acceptable results for higher Mach numbers. A new method for obtaining a smooth, and suitable, Mach number distribution along the axis of symmetry was developed, based on a smooth 'area variation' along the axis. This approach was successful for the higher Mach number hypersonic range. Focus is on air nozzles with gamma equals 1.4 but the effects of different values of gamma were studied. The main interest was in hypersonic nozzles for which the Reynolds number was likely to be low enough for the boundary layer to be laminar. Therefore the boundary layer growth was calculated based on the methods of Luxton and Young. Two methods of calculation were tried. The modified, or improved, version was used. ESA

N93-16695*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
APPROACHES TO CONTROL OF THE LARGE ANGLE MAGNETIC SUSPENSION TEST FIXTURE Annual Progress Report, 1 Nov. 1991 - 31 Oct. 1992
Mehran Ghofrani and Colin P. Britcher Dec. 1992 126 p
(Grant NAG1-1056)
(NASA-CR-191890; NAS 1.26:191890) Avail: CASI HC A07/MF A02

The Large Angle Magnetic Suspension Test Fixture is a five degree-of-freedom system, developed and built at NASA Langley Research Center. It is intended for study of control techniques in magnetic suspension systems with large angular capabilities. In this study, steps have been taken to prove the system in practice, using the existing hardware. A classical control approach, using dual phase advance compensators, is applied in simulation and hardware. A single decoupled degree-of-freedom of the system is stabilized and controlled in simulation. The procedure is then employed for all five degrees-of-freedom. The design and implementation of an analog and a digital controller are described. Results from simulation and the actual system are compared and analyzed. The ability to the system to sustain suspension over a large angular range has been proven in hardware. Author

N93-16753*# National Aeronautics and Space Administration. Flight Research Center, Edwards, CA.
THE F-18 SYSTEMS RESEARCH AIRCRAFT FACILITY
Joel R. Sitz Dec. 1992 32 p Presented at the 1992 Aerotech Conference, Anaheim, CA, 5-8 Oct. 1992
(RTOP 505-68-52)
(NASA-TM-4433; H-1844; NAS 1.15:4433) Avail: CASI HC A03/MF A01

To help ensure that new aerospace initiatives rapidly transition to competitive U.S. technologies, NASA Dryden Flight Research Facility has dedicated a systems research aircraft facility. The primary goal is to accelerate the transition of new aerospace technologies to commercial, military, and space vehicles. Key technologies include more-electric aircraft concepts, fly-by-light systems, flush airdata systems, and advanced computer architectures. Future aircraft that will benefit are the high-speed civil transport and the National AeroSpace Plane. This paper describes the systems research aircraft flight research vehicle and outlines near-term programs. Author

N93-17687# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA.
SIMULATOR MOTION Final Report, Jun. 1990 - Dec. 1991
John A. Boldovici Sep. 1992 37 p
(DA Proj. 2Q2-63007-A-795)
(AD-A257683; ARI-TR-961) Avail: CASI HC A03/MF A01

This review analyzes the arguments for and against using various methods of force motion cuing in land-vehicle and aircraft simulators. Research literature was reviewed and opinions were solicited from 31 authorities, 24 of whom replied. Analysis of the literature and of the reasons given by the authorities for and against the use of force motion cuing indicated the following: (1) no transfer of training data support using motion-based rather than fixed-base simulators; (2) the absence of supporting data may be due to the unknown characteristics of motion used in transfer research, safety considerations that preclude conducting definitive transfer of training experiments, and deficiencies in experiments that lead to inadequate statistical power; and (3) objective examination of the effects of force motion cuing on transfer to land vehicles and aircraft requires developing and using reliable and safe tests for assessing the performance of tasks that cannot safely be performed in parent vehicles. In the absence of transfer data demonstrating the superiority of fixed-based or motion-based simulators, analyses to identify discriminative stimuli are recommended. The report presents algorithms for deciding for which tasks the use of force motion cuing in training is likely to facilitate transfer to parent vehicles and for deciding whether seat shakers, g-seats, or motion bases are sufficient to provide discriminative stimuli for task performance. GRA

N93-17708# Army Cold Regions Research and Engineering Lab., Hanover, NH.
STATE-OF-THE-ART SURVEY OF FLEXIBLE PAVEMENT CRACK

SEALING PROCEDURES IN THE UNITED STATES
Robert A. Eaton and Jane Ashcraft Sep. 1992 25 p
(AD-A258050; CRREL-92-18) Avail: CASI HC A03/MF A01

A survey of all 50 United States was conducted in September of 1990 to determine the state of the art of crack sealing procedures on flexible asphalt concrete pavements. The results were tabulated and a summary report prepared. A meeting was held at the U.S. Army Cold Regions Research and Engineering Laboratory to discuss the draft report; the comments and suggestions received were incorporated into this report. At the meeting, the group identified the need for a trade organization to develop uniform specifications and terminology and to promote proper equipment, methodology, materials, training, and education in the pavement crack sealing industry. GRA

N93-17734# Naval Civil Engineering Lab., Port Hueneme, CA.
AN EXPERIMENTAL EXAMINATION OF THE THERMAL AND ACOUSTIC ENVIRONMENTS ON RUNWAY JOINT SEALS Final Report, Jun. 1988 - Sep. 1989
E. E. Cooper and C. Dahl Sep. 1992 107 p
(NR Proj. Y13-16)
(AD-A257965; NCEL-N-1846) Avail: CASI HC A06/MF A02

A test series was conducted at Edwards Air Force Base to determine noise and temperature environments that joint seal materials experience on an operational runway. Impingement of exhaust flow from jet engines creates an aerothermal environment for joint seal materials that contributes to, and accelerates, the deterioration and failure of joint seals. The aerothermal environment consists of noise (considered in this report as acoustically-induced as well as flow-induced fluctuations) and temperature. Current specifications for runway joint seal materials do not consider the effects of noise. The test data in this report show noise levels of 164 db at the joint seal surface. The conclusion is that the potential for energy transfer from exhaust flow noise is almost as high as the potential for energy transfer from exhaust flow temperature. GRA

N93-17793# Federal Aviation Administration, Washington, DC. Office of Airport Planning and Programming.
ESTIMATING THE REGIONAL ECONOMIC SIGNIFICANCE OF AIRPORTS
Stewart E. Butler and Laurence J. Kiernan Sep. 1992 63 p
(AD-A257658; DOT/FAA/PP-92-6) Avail: CASI HC A04/MF A01

The United States has the world's most extensive airport system. The system is essential to national transportation, and there is a large Federal investment in it. However, most public airports are owned and operated by units of local government. Public airports must compete for funds with other governmental activities. They are scrutinized during budget preparation and may be the subject of public debate, particularly if major improvements or new construction are anticipated. They may even be the target of proposed restrictions aimed at limiting aircraft noise levels. In such instances, the future of an airport is determined primarily through the local political process. It is important that the public and their representatives appreciate the economic significance of airports if they are to continue to support them. This report is designed to assist analyses of the economic importance of airports. It is not intended for use in financial feasibility studies or cost/benefit analyses. Rather, it provides information that the average citizen may find useful when the current and future role of an airport is being discussed. One objective is to encourage a standard approach to the measurement of the economic significance of airports. GRA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N93-16629*# Virginia Univ., Charlottesville. School of Engineering and Applied Science.
TECHNICAL NEEDS AND RESEARCH OPPORTUNITIES PROVIDED BY PROJECTED AERONAUTICAL AND SPACE SYSTEMS Final Report, 1 Aug. 1990 - 31 May 1991
Ahmed K. Noor Apr. 1992 24 p
(Grant NAGw-2266)
(NASA-CR-192124; NAS 1.26:192124; UVA/528366/CE92/101) Avail: CASI HC A03/MF A01

The overall goal of the present task is to identify the enabling and supporting technologies for projected aeronautical and space systems. A detailed examination was made of the technical needs in the structures, dynamics and materials areas required for the realization of these systems. Also, the level of integration required with other disciplines was identified. The aeronautical systems considered cover the broad spectrum of rotorcraft; subsonic, supersonic and hypersonic aircraft; extremely high-altitude aircraft; and transatmospheric vehicles. The space systems considered include space transportation systems; spacecrafts for near-earth observation; spacecrafts for planetary and solar exploration; and large space systems. A monograph is being compiled which summarizes the results of this study. The different chapters of the monograph are being written by leading experts from governmental laboratories, industry and universities. Author

N93-16950# National Space Council, Washington, DC.
REPORT TO THE PRESIDENT ON THE US SPACE PROGRAM Final Report
Jan. 1993 85 p Original contains color illustrations
(ISBN-0-16-041608-6) Avail: CASI HC A05/MF A01; SOD HC

This presidential report covers the following topics: space leadership, space transportation, national security, Mission to Planet Earth, Mission from Planet Earth, international space activity, space commerce and trade, planning for the future, chronology of Bush Administration Space Policy Activities, the executive order establishing the National Space Council, and National Space Policy Directives. Author

N93-17218# Space Policy Advisory Board, Washington, DC.
A POST COLD WAR ASSESSMENT OF US SPACE POLICY
Dec. 1992 77 p Original contains color illustrations
Avail: CASI HC A05/MF A01

The V.P. of the US, Dan Quayle, asked his Space Policy Advisory Board to conduct a review of current national space policy. He charged them with making policy recommendations that would: increase the efficiency of federal government space activities to enable the best space program possible for the funds available; maintain US leadership and competitiveness for the 21st century; and sustain an industrial base capable of supporting future national security, civil, and commercial space requirements. The group has completed this review and found that space systems and missions remain important elements of government activity. Specifically, some findings are: current space activities are not appropriate for post Cold War era; economic competitiveness of the space related industrial sector promotes civil and national security interest; and enhanced international cooperation presents an opportunity for the US which should be pursued. The group recommends that the US: change the way space activities are organized and managed; reduce and eliminate security constraints associated with national security; revitalize a more productive cooperation between the government and the space industry; and take the initiative in shaping a common international agenda in selected areas of civil and national security space activity to address global problems and to maintain US influence. E.R.

N93-16858*# Andersen (Arthur) and Co., New York, NY.
NASA IN THE 21ST CENTURY: A VISION OF GREATNESS
Kathleen J. Murphy *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 16-119 (For primary document see N93-16857 05-91)
Avail: CASI HC A06/MF A03; SOD HC; 4 functional color pages

N93-16864*# Texas Univ., San Antonio.
FUTURE SPACE DEVELOPMENT SCENARIOS: ENVIRONMENTAL CONSIDERATIONS
Richard Tangum *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 220-230 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

N93-17315*# Auburn Univ., AL. Dept. of Computer Science and Engineering.
A PROCESS FOR PROTOTYPING ONBOARD PAYLOAD DISPLAYS FOR SPACE STATION FREEDOM

Loretta A. Moore *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N93-16302# Los Alamos National Lab., NM.
MODIFICATION OF EARTH-SATELLITE ORBITS USING MEDIUM-ENERGY PULSED LASERS
C. R. Phipps 1992 6 p Presented at the 9th International Symposium on Gas Flow and Chemical Lasers, Heraklion, Greece, 21-25 Sep. 1992 (Contract W-7405-eng-36)
(DE93-000858; LA-UR-92-3074; CONF-920959-2) Avail: CASI HC A02/MF A01

Laser Impulse Space Propulsion (LISP) has become an attractive concept, due to recent advances in gas laser technology, high-speed segmented mirrors and improved coefficients for momentum coupling to targets in pulsed laser ablation. There are numerous specialized applications of the basic concept to space science - ranging from far-future and high capital cost to the immediate and inexpensive, such as: LEO-LISP (launch of massive objects into low-Earth-Orbit at dramatically improved cost-per-kg relative to present practice); LEGO-LISP (LEO to geosynchronous transfers); LO-LISP (periodic re-boost of decaying LEO orbits); and LISK (geosynchronous satellite station-keeping). It is unlikely that one type of laser will be best for all scenarios. In this paper, we will focus on the last two applications. DOE

N93-16518 California Univ., Los Angeles.
ROBUST APPROXIMATE OPTIMAL GUIDANCE STRATEGIES FOR AEROASSISTED ORBITAL TRANSFER MISSIONS Ph.D. Thesis
Marc R. Ilgen 1992 337 p
Avail: Univ. Microfilms Order No. DA9230781

This thesis presents the application of game theoretic and regular perturbation methods to the problem of determining robust approximate optimal guidance laws for aeroassisted orbital transfer missions with atmospheric density and navigated state uncertainties. The optimal guidance problem is reformulated as a differential game problem with the guidance law designer and Nature as opposing players. The resulting equations comprise the necessary conditions for the optimal closed loop guidance strategy in the presence of worst case parameter variations. While these equations are nonlinear and cannot be solved analytically, the presence of a small parameter in the equations of motion allows the method of regular perturbations to be used to solve the equations approximately. This thesis is divided into five parts. The first part introduces the class of problems to be considered and presents results of previous research. The second part then presents explicit semianalytical guidance law techniques for the aerodynamically dominated region of flight. These guidance techniques are applied to unconstrained and control constrained aeroassisted plane change missions and Mars aerocapture missions, all subject to significant atmospheric density variations. The third part presents a guidance technique for aeroassisted orbital transfer problems in the gravitationally dominated region of flight. Regular perturbations are used to design an implicit guidance technique similar to the second variation technique but that removes the need for numerically computing an optimal trajectory prior to flight. This methodology is then applied to a set of aeroassisted inclination change missions. In the fourth part, the explicit regular perturbation solution technique is extended to include the class of guidance laws with partial state information. This methodology is then applied to an aeroassisted plane change mission using inertial measurements and subject to uncertainties in the initial value of the flight path angle. A summary of performance results for all these guidance laws is presented in the fifth part of this thesis along with recommendations for further research. Dissert. Abstr.

N93-17290*# Alabama Univ., Huntsville. Dept. of Mathematical Sciences.
OPTIMAL TRAJECTORIES FOR ORBITAL TRANSFERS USING LOW AND MEDIUM THRUST PROPULSION SYSTEMS
Shannon S. Cobb *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N93-15783# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany).
RECENT DEVELOPMENTS IN CONTROLLING A HYDRAULIC MULTI-AXIS TEST FACILITY
G. Lachenmayr *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 951-957 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-17457*# Missouri Univ., Columbia.
A MANNED EXOBIOLOGY LABORATORY BASED ON THE MOON
Charles W. Gehrke, Cyril Ponnamperuma (Maryland Univ., College Park.), Kenneth C. Kuo, John E. McEntire (Cancer Research Center, Columbia, MO.), David L. Stalling (Interior Dept., Columbia, MO.), and Robert W. Zumwalt *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 351-352 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N93-16284# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
NONLINEAR ANALYSIS OF ARIANE 5 ENGINE FRAME
D. Vandepitte (Fokker Space and Systems, Amsterdam, Netherlands) and E. Riks 18 Mar. 1992 95 p
(LR-678; ETN-92-92873) Avail: CASI HC A05/MF A01

A finite element analysis of the load carrying capacity of the main stage support structure of the Ariane 5 launcher is considered. Several finite element models of the engine support were constructed with the finite element code MSC/NASTRAN. The calculations that were carried out concern the nonlinear behavior of these models under various loading conditions (which are based on the predicted launch scenario). These calculations determine the collapse load of the structure. The results of the calculations show that the engine support will not fail before or at the load that corresponds to the predicted design strength (which is based on conservative 'local buckling' criteria). In all cases there was a comfortable margin of safety, exceeding 2 in all load cases. Considering the fact that the finite element models used represent many structural details, it is concluded that the structure will meet its strength specifications. ESA

N93-16540 Georgia Inst. of Tech., Atlanta.
A REAL-TIME NEAR-OPTIMAL GUIDANCE APPROACH FOR LAUNCH VEHICLES Ph.D. Thesis
Martin Siu-Kee Leung 1992 141 p
Avail: Univ. Microfilms Order No. DA9231741

The thesis is to study and to develop a real-time guidance approach for launch vehicles ascent to orbit injection. Various analytical approaches combined with a variety of model order and model complexity reduction have been investigated. Singular perturbation methods are first attempted,

and are found to be unsatisfactory. The second approach is based on regular perturbation analysis. It also fails because the aerodynamic effects (ignored in the zero-order solution) are too large to be treated as perturbations. Therefore, one major contribution of the thesis is an exhaustive study and simulation effort which demonstrates conclusively that perturbation methods alone (both regular and singular perturbations) are inadequate for use in developing a guidance algorithm for the launch vehicle atmospheric flight phase. The second major contribution lies in the development of a hybrid approach that is suitable for real-time guidance. The approach combines the numerical method of collocation and the analytical method of regular perturbation. The concept of choosing intelligent interpolating functions is also introduced. Regular perturbation analysis allows the use of a crude representation for the collocation solution, and intelligent interpolating functions further reduce the number of elements without sacrificing the approximation accuracy. As a result, the combined method forms a powerful tool for solving real-time optimal control problems. Details of the application are illustrated in a fourth-order nonlinear example. The hybrid approach is then applied to a launch vehicle problem. The example is a 2-stage heavy-lift capacity vehicle launched to a low earth transfer orbit. The collocation solution is derived from a bilinear tangent steering law, and results in a guidance solution for the entire flight regime, that includes both atmospheric and exoatmospheric flight phases. Assessment of performance and reliability are demonstrated through closed-loop simulations. Solutions are compared with off-line optimal results generated from a multiple shooting code. The hybrid guidance approach delivers over 99.9 percent of performance and orbit injection accuracy while the control computation is completed in tenths of a second on a SPARCstation 1. Wind shear effects and a control constraint are also addressed in the analysis. Dissert. Abstr.

N93-16654*# Illinois Univ. Observatory, Urbana.
SPACEBORNE CENTRIFUGAL RELAYS FOR SPACECRAFT PROPULSION Final Report
Malika Ouzidane 1991 142 p
(Grant NAG3-1037)
(NASA-CR-191773; NAS 1.26:191773) Avail: CASI HC A07/MF A02

Acceleration using centrifugal relays is a recently discovered method for the acceleration of spaceborne payloads to high velocity at high thrust. Centrifugal relays are moving rotors which progressively accelerate reaction mass to higher velocities. One important engineering problem consists of accurately tracking the position of the projectiles and rotors and guiding each projectile exactly onto the appropriate guide tracks on each rotor. The topics of this research are the system kinematics and dynamics and the computerized guidance system which will allow the projectile to approach each rotor with exact timing with respect to the rotor rotation period and with very small errors in lateral positions. Kinematics studies include analysis of rotor and projectile positions versus time and projectile/rotor interactions. Guidance studies include a detailed description of the tracking mechanism (interrupt of optical beams) and the aiming mechanism (electromagnetic focusing) including the design of electromagnetic deflection coils and the switching circuitry. Author

N93-15764# Construcciones Aeronauticas S.A., Madrid (Spain). Space Div.
EXPERIMENTAL APPROACH ON THE PYROTECHNICAL SHOCK REDUCTION OF ARIANE-5 UPPER STAGE
I. Uribarri, P. Tejero, B. Rivaillon (MATRA Espace, Toulouse, France), and B. Laviron (MATRA Espace, Toulouse, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 813-818
(For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N93-16556*# Martin Marietta Corp., Denver, CO. Astronautics Group.
SPACE TRANSFER VEHICLE CONCEPTS AND REQUIREMENTS. VOLUME 2, BOOK 2: APPENDIX
Apr. 1991 119 p
(Contract NAS8-37856)
(NASA-CR-184490; NAS 1.26:184490; MCR-91-7503-Vol-2-Bk-2) Avail: CASI HC A06/MF A02

This appendix describes the work that was performed to define the Lunar transfer vehicle and Lunar excursion vehicle which were part of the 'Report of the 90-Day Study on Human Exploration of the Moon and Mars.' A detailed concept definition of both vehicles including overall dimensions, mass properties, subsystem definition, and operational flight sequences is included. Author

N93-16660*# Boeing Aerospace Co., Seattle, WA. Defense and Space Group.
SPACE TRANSFER VEHICLE CONCEPTS AND REQUIREMENTS STUDY, PHASE 2 Final Report
Jeffrey H. Cannon, Tim Vinopal, Dana Andrews, Bill Richards, Gary Weber, Greg Paddock, Peter Maricich, Bruce Bouton, Jim Hagen, and Richard Kolesar et al 29 Oct. 1992 300 p
(Contract NAS8-37855)
(NASA-CR-191425; NAS 1.26:191425; D658-10010-1) Avail: CASI HC A13/MF A03

This final report is a compilation of the Phase 1 and Phase 2 study findings and is intended as a Space Transfer Vehicle (STV) 'users guide' rather than an exhaustive explanation of STV design details. It provides a database for design choices in the general areas of basing, reusability, propulsion, and staging; with selection criteria based on cost, performance, available infrastructure, risk, and technology. The report is organized into the following three parts: (1) design guide; (2) STV Phase 1 Concepts and Requirements Study Summary; and (3) STV Phase 2 Concepts and Requirements Study Summary. The overall objectives of the STV study were to: (1) define preferred STV concepts capable of accommodating future exploration missions in a cost-effective manner; (2) determine the level of technology development required to perform these missions in the most cost effective manner; and (3) develop a decision database of programmatic approaches for the development of an STV concept. Author

N93-16672*# Martin Marietta Corp., Denver, CO. AStronautics GRoup.
SPACE TRANSFER VEHICLE CONCEPTS AND REQUIREMENTS. VOLUME 1: EXECUTIVE SUMMARY
Apr. 1991 132 p
(Contract NAS8-37856)
(NASA-CR-184488; NAS 1.26:184488; MCR-91-7503-Vol-1) Avail: CASI HC A07/MF A02

The objectives of the Space Transfer Vehicle (STV) Concepts and Requirements studies were to provide sensitivity data on usage, economics, and technology associated with new space transportation systems. The study was structured to utilize data on the emerging launch vehicles, the latest mission scenarios, and Space Exploration Initiative (SEI) payload manifesting and schedules, to define a flexible, high performance, cost effective, evolutionary space transportation system for NASA. Initial activities were to support the MSFC effort in the preparation of inputs to the 90 Day Report to the National Space Council (NSC). With the results of this study establishing a point-of-departure for continuing the STV studies in 1990, additional options and mission architectures were defined. The continuing studies will update and expand the parametrics, assess new cargo and manned ETO vehicles, determine impacts on the redefined Phase 0 Space Station Freedom, and to develop a design that encompasses adequate configuration flexibility to ensure compliance with on-going NASA study recommendations with major system disconnects. In terms of general requirements, the objectives of the STV system and its mission profiles

will address crew safety and mission success through a failure-tolerant and forgiving design approach. These objectives were addressed through the following: engine-out capability for all mission phases; built-in-test for vehicle health monitoring to allow testing of all critical functions such as, verification of lunar landing and ascent engines before initiating the landing sequence; critical subsystems will have multiple strings for redundancy plus adequate supplies of onboard spares for removal and replacement of failed items; crew radiation protection; and trajectories that optimize lunar and Mars performance and flyby abort capabilities. Author

N93-16686*# Martin Marietta Corp., Denver, CO. Astronautics Group.
SPACE TRANSFER VEHICLE CONCEPTS AND REQUIREMENTS, VOLUME 2, BOOK 1
Apr. 1991 365 p
(Contract NAS8-37856)
(NASA-CR-184489; NAS 1.26:184489; MCR-91-7503-Vol-2-Bk-1) Avail: CASI HC A16/MF A03

The objective of the systems engineering task was to develop and implement an approach that would generate the required study products as defined by program directives. This product list included a set of system and subsystem requirements, a complete set of optimized trade studies and analyses resulting in a recommended system configuration, and the definition of an integrated system/technology and advanced development growth path. A primary ingredient in the approach was the TQM philosophy stressing job quality from the inception. Included throughout the Systems Engineering, Programmatics, Concepts, Flight Design, and Technology sections are data supporting the original objectives as well as supplemental information resulting from program activities. The primary result of the analyses and studies was the recommendation of a single propulsion stage Lunar Transportation System (LTS) configuration that supports several different operations scenarios with minor element changes. This concept has the potential to support two additional scenarios with complex element changes. The space based LTS concept consists of three primary configurations--Piloted, Reusable Cargo, and Expendable Cargo. Author

N93-16688*# Martin Marietta Corp., Denver, CO. Astronautics Group.
SPACE TRANSFER VEHICLE CONCEPTS AND REQUIREMENTS. VOLUME 3: PROGRAM COST ESTIMATES
Apr. 1991 38 p
(Contract NAS8-37856)
(NASA-CR-184491; NAS 1.26:184491; MCR-91-7504-Vol-3) Avail: CASI HC A03/MF A01

The Space Transfer Vehicle (STV) Concepts and Requirements Study has been an eighteen-month study effort to develop and analyze concepts for a family of vehicles to evolve from an initial STV system into a Lunar Transportation System (LTS) for use with the Heavy Lift Launch Vehicle (HLLV). The study defined vehicle configurations, facility concepts, and ground and flight operations concepts. This volume reports the program cost estimates results for this portion of the study. The STV Reference Concept described within this document provides a complete LTS system that performs both cargo and piloted Lunar missions. Author

N93-17309*# Alabama Univ., Huntsville. Dept. of Aerospace Engineering.
DIRECTIONS FOR FUTURE EARTH-TO-ORBIT VEHICLES
James A. Martin *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N93-17659# Woods Hole Oceanographic Inst., MA.
MicroSat DATA TELEMETRY Status Report
James R. Valdes Jun. 1992 25 p
(Contract N00014-90-C-0013)
(AD-A257468; WHOI-92-25) Avail: CASI HC A03/MF A01

The intent of this project was to test and evaluate a new data collection concept; that of utilizing a store and forward message system in a low earth orbiting satellite, and to determine its suitability for oceanographic data telemetry. This new generation of satellites, dubbed MicroSats because of their small size (a 9 in. cube), was developed by the Amateur Radio Satellite Corporation (AMSAT) to complement the existing HF and VHG terrestrial Packet data switching networks. GRA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N93-15713*# Alabama Univ., Huntsville.
CRRES: THE COMBINED RELEASE AND RADIATION EFFECTS SATELLITE PROGRAM DIRECTORY
Laura D. Layman and George P. Miller 20 Nov. 1992 167 p
(Contract NAS8-38609)
(NASA-CR-184504; NAS 1.26:184504) Avail: CASI HC A08/MF A02

As a result of natural processes, plasma clouds are often injected into the magnetosphere. These chemical releases can be used to study many aspects of such injections. When a dense plasma is injected into the inner magnetosphere, it is expected to take up the motion of the ambient plasma. However, it has been observed in previous releases at moderate altitudes that the cloud preserved its momentum for some time following the release and that parts of the cloud peeled off from the main cloud presumable due to the action of an instability. As one moves outward into the magnetosphere, the mirror force becomes less dominant and the initial conditions following a release are dominated by the formation of a diamagnetic cavity since the initial plasma pressure from the injected Ba ions is greater than the magnetic field energy density. A previous high-altitude release (31,300 km) showed this to be the case initially, but at later times there was evidence for acceleration of the Ba plasma to velocities corresponding to 60,000 K. This effect is not explained. This series of experiments is therefore designed to inject plasma clouds into the magnetosphere under widely varying conditions of magnetic field strength and ambient plasma density. In this way the coupling of injected clouds to the ambient plasma and magnetic field, the formation of striations due to instabilities, and possible heating and acceleration of the injected Ba plasma can be studied over a wide range of magnetosphere parameters. Adding to the scientific yield will be the availability of measurements for the DOD/SPACERAD instruments which can monitor plasma parameters, electric and magnetic fields, and waves before, during and after the releases.
Author

N93-15718# European Space Agency, Paris (France).
SPACECRAFT STRUCTURES AND MECHANICAL TESTING, VOLUME 2
W. R. Burke, comp. (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) Oct. 1991 455 p In ENGLISH and FRENCH Conference held in Noordwijk, Netherlands, 24-26 Apr. 1991; sponsored by ESA, CNES, and DLR
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Avail: CASI HC A20/MF A04

Papers presented at the conference were directly associated with space project applications of scientific, Earth observation and telecommunication satellites, reporting hardware design, development, testing and other related experiences of major space contractors, and covered important advances in satellite structural design, development and verification. Volume 2 presents sessions on the following: design and development (mechanical systems, structures); analysis (fluid structure interaction); vibroacoustics, materials (fracture, damage mechanics, metallic structures); testing (methods, facilities);

multibody dynamics (deployment mechanics); dynamic identification; antenna design; and computer aided design/engineering (methods and interfaces). For individual titles, see N93-15719 through N93-15787.

N93-15719# Kassel Univ. (Germany).
UPDATING AND LOCALIZING STRUCTURAL ERRORS BASED ON MINIMIZATION OF EQUATION ERRORS
Michael Link and Oscar FloresSantiago *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 503-510 (For primary document see N93-15718 05-18)
(Contract ESTEC-8218/89/NL/PU)
Copyright Avail: CASI HC A02/MF A04

The theory and applications of a method of updating computational models including methods for localizing regions with dominant modeling errors are presented. The method is based on equation errors combined with eigenvalue errors. The procedures were derived with respect to handling incomplete test vectors, where the number of measured Degrees Of Freedom (DOF) is much less than the number of DOF of the computational model. Error indicator functions were introduced to detect regions with dominant modeling errors. Applications are presented for the real test structure RESMOD which exhibits a dynamic behavior typical for a satellite structure. The procedures were first applied to two substructures. The updated substructure matrices were then used for coupled analyses and their results were subsequently compared with the test results of the assembled structure. This approach allowed a check of whether one of the important goals of the updating process, to improve the coupled analysis results, could be achieved or not. ESA

N93-15720# Frazer-Nash Consultancy Ltd., Leatherhead (England).
THE USE OF INVERSE FREQUENCY RESPONSE FUNCTIONS FOR MULTI DEGREE-OF-FREEDOM MODAL PARAMETER IDENTIFICATION WITH ERROR BOUNDS
T. A. Brown, C. J. Kenchington, and N. E. Kirk *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 511-516
Sponsored by United Kingdom Ministry of Defence Procurement Executive
(For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

A method which uses inverse frequency response functions to determine the modal parameters of a dynamic system is described. The method is developed to provide additional information on the error bounds associated with these parameters from information available from multiple measurements. An example is used to illustrate the technique and a comparison is made with the complex exponential method. ESA

N93-15721# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany).
MODAL IDENTIFICATION OF MECHANICAL STRUCTURES BY MEANS OF TUNED BASE-MOTION EXCITATION
K. Muehlbauer, S. Dillinger, and J. Salzmann *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 517-522 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

Based on the capability of a multiaxial vibration test facility to independently control every rigid body degree of freedom of the vibration table, a modal identification technique making use of tuned base motion excitation is proposed. It consists of tuning every base motion degree of freedom such that the whole structure is coherently vibrating in quadrature to the input motion. Test data acquired on the structural model of a modern spacecraft structure during a study on multiaxial testing are used to demonstrate the performance of this method and to illustrate its identification potential. ESA

N93-15722# Computational Mechanics Inst., Southampton (England).
ANALYSIS OF FLUID STRUCTURE INTERACTION OF SPACECRAFT'S FLUID TANKS USING COMBINED BOUNDARY ELEMENT AND FINITE ELEMENT METHODS
S. M. Niku, R. A. Adey, M. Klein (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands), W. Teichert (IKO Software Service G.m.b.H., Stuttgart, Germany), and M. Kries (Kreis Consultancies, Rudlingen, Switzerland) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 525-533
Sponsored by ESA/ESTEC (For primary document see N93-15718 05-18)
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An algorithm by which a Boundary Element (BE) and a Finite Element (FE) system are combined to solve the problems of fluid structure interaction of fluid tanks is presented. The fluid is assumed to be incompressible and motion limited to small amplitudes. It is shown that a combined system can provide an optimum analysis environment in which FE method is used to model the thin walled tank and BE method to represent the fluid in the tank. Based on this idea, a coupled system which employs BEASY (BE program) and ASKA (FE program) analysis modules to generate the fluid and structural matrices was developed. These matrices are then combined along the wetted surface between the tank and fluid by considering the appropriate equilibrium and compatibility conditions. Example problems presented include analyses of a full fluid filled tank, a cylindrical canal, and a typical spacecraft's fluid tank. ESA

N93-15723# IKO Software Service G.m.b.H., Stuttgart (Germany).
SOME ASPECTS FOR THE APPLICATION OF A HIERARCHIC FAMILY OF HERRMANN MIXED COMPRESSIBLE AND INCOMPRESSIBLE FINITE ELEMENTS **c39**
F. Kiss *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 535-540 (For primary document see N93-15718 05-18)
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Such materials as rubber, rocket propellants, or materials that flow, such as fluids or plastic solids, are often modeled to be incompressible. For the analysis of incompressible problems, a series of element formulations and solution procedures were recently adopted and tested in the finite element system ASKA. Some of the experiences gained during the implementation of a hierarchy family of mixed Herrmann finite elements are considered. ESA

N93-15724# National Aerospace Lab., Amsterdam (Netherlands).
SPACECRAFT SUSTAINED LOAD FRACTURE CONTROL
R. J. H. Wanhill *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 543-549 (For primary document see N93-15718 05-18)
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Sustained load fracture control is a problem of particular importance for manned spacecraft and orbital stations, owing to the long design lives and limited opportunities for repair. The current ESA approach is based on screening out materials shown to be susceptible to stress corrosion cracking from smooth specimen tests. This approach has worked well for over twenty years, but does not fit into the context of ESA fracture control guidelines. Nor does it consider other types of sustained load fracture. These limitations can be addressed by a comprehensive sustained load fracture control plan. Such a plan is defined and its scope is indicated. Emphasis is given to verification of sustained load fracture control by small scale laboratory testing. ESA

N93-15725# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Strukturmechanik.
CRACK INITIATION AND GROWTH IN NOTCHED CFRE LAMINATES: FEM ANALYSES AND TESTS **c24**
Michael Gaedke *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 987-992 (For primary document see N93-15718 05-18)
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With the emerging trend towards strength critical applications of Carbon Fiber Reinforced (CFRE) laminates, the need for a more rigorous approach to the characterization of laminates with deep insight into the damage mechanisms is evident, especially in regard to multidirectional laminates containing holes and notches due to practical applications, but then the prediction of the static and fatigue strengths is considerably complicated. First results of numerical analyses for crack initiation and growth in UD laminates with edge notches and central holes in combination with a quadratic failure criterion are presented, which gives a clear insight into the failure mechanisms. The calculation of the stress exertion ratio (in dependence of fiber orientation) by means of stress distributions gives the experimentally measured length and direction of a crack growing. In connection with the characteristic damage state of crossply laminates, the

coupling effect to delamination growth under compressive load was analyzed. A first step towards the advance calculation of damaged areas for center notched multidirectional laminates under tensile loading is shown. ESA

N93-15726# Norske Veritas, Oslo.
AN ANALYTICAL AND EXPERIMENTAL STUDY ON THE DESIGN AND VERIFICATION OF CONTAINMENT SUBJECTED TO IMPACT LOADING **c39**
Olav Fyrileiv, Magne K. Nygaard, Jens P. Tronskar (Veritas Research A.S., Hovik, Norway), and Stig Waestberg (Veritas Research A.S., Hovik, Norway) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 553-558 (For primary document see N93-15718 05-18)
(Contract ESTEC-8141/89/NL/PH(SC))
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The design of space systems and associated equipment has to be based on fracture control principles to prevent failure of certain structural items resulting in catastrophic or critical events. In order to prevent such catastrophic hazards from occurring, use of containment design is an attractive option. A simplified analytical method for verification of containment is developed and described. This method takes into account the elastic and plastic deformation of containment shields consisting of thin, ductile plates hit by a loose item with a velocity up to 40 m/s. The capacity to dissipate kinetic energy is dependent on both the plate response and the relevant perforation failure mechanism. Verification of the analytical method was performed through an extensive test program consisting of 181 static and dynamic impact tests using three different aluminum alloys (AA 2024-0, AA 7075-T6, and AA 6061-T6) for the plates. ESA

N93-15727*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
STRUCTURAL DEVELOPMENT OF FLIGHT SYSTEMS
Michael C. Lou *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 559-566 (For primary document see N93-15718 05-18)
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An overview of the typical process and timeline for the development of structural systems is presented. Structural design and verification requirements, along with the approaches used to implement these requirements, are discussed. Special considerations are given to limit loads estimation, structural qualification by analysis, modal survey and test/analysis correlation, and response limiting during vibration tests. Several controversal issues that cause inconsistencies and difficulties in the current structural development process are identified and an approach for resolving these issues is recommended. ESA

N93-15728# Saab-Space A.B., Linkoeping (Sweden).
SAMPLE CONTAINER TECHNOLOGY
Hans Grunditz *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 567-571 (For primary document see N93-15718 05-18)
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Different technologies to design and manufacture a container for carrying deep cooled comet test samples back to Earth are discussed. Different concepts are described and traded against each other. The design driving aspects and the parameters used for the tradeoff are the following: low mass, high thermal insulation, high mechanical stiffness, hermetical sealing of container and sample tubes, capability to withstand overpressure, reliable operation, and easy mounting of container/opening of sample tubes. A tentative design of the sample container is presented together with a mass budget, thermal and structural dynamic analysis, and verification test sequence for proof of the concept. ESA

N93-15729# Alenia Spazio S.p.A., Rome (Italy). Space Antenna Group.
ORBITAL MANOEUVRE EFFECTS ON LARGE FLEXIBLE ANTENNAE **c32**
William Adam, Alberto Bramante, and Alberto Meschini *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 575-577 (For primary document see N93-15718 05-18)
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Future European Data Relay System Satellites (DRSS) are requiring ever more stringent communication performance towards the low Earth users and/or ground stations. Hence, the necessary antennae are large and flexible and even the smaller orbital disturbances must be considered in the pointing budget. The effects of the orbital maneuver for the case of the Artemis S band Rx antenna are presented. The antenna maximal depointing, taking into account a typical load time history for orbital maneuvers, was computed. An actual design feedback for a better definition of the antenna stiffness requirement was achieved. ESA

N93-15730*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ADAPTIVE STRUCTURES FOR PRECISION CONTROLLED LARGE SPACE SYSTEMS
John A. Garba, Ben K. Wada, and James L. Fanson *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 579-587 (For primary document see N93-15718 05-18)
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The stringent accuracy and ground test validation requirements of some of the future space missions will require new approaches in structural design. Adaptive structures, structural systems that can vary their geometric congiguration as well as their physical properties, are primary candidates for meeting the functional requirements for such missions. Research performed in the development of such adaptive structural systems is described. ESA

N93-15731# Mitsubishi Electric Corp., Tokyo (Japan). Space Communications Research Div.
TRADEOFF AND SCALE MODELS OF LARGE DEPLOYABLE MESH REFLECTORS FOR MOBILE COMMUNICATIONS SATELLITE
Toshio Sugimoto, Akio Iso, Shin-Ichi Sato, and Teruaki Orikasa *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 589-593 (For primary document see N93-15718 05-18)
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The key technologies of a large deployable mesh reflector, and the tradeoff of mechanical performances are described. A scaled mesh reflector (1/10 model) is constructed for design of a 30 m diameter deployable reflector. Mechanical performances are measured. A mass conversion method is proposed for finding the most effective technology of large deployable reflectors. The tradeoffs of large deployable mesh reflectors are analytically investigated. It is shown that the hexagonal prism reflector is the best regarding surface accuracy. The hybrid truss type reflector proposed is the best regarding rigidity. This reflector has a compound module of a triangular prism and a hexagonal prism. Two scale models were constructed, and the test results are shown. ESA

N93-15732# Intespace, Toulouse (France).
DEVELOPMENT OF AN INTERACTIVE CODE FOR UPDATING DYNAMIC FINITE ELEMENT MODELS **c39**
N. A. Roy, A. Girard, P.-E. Dupuis, and L.-P. Bugeat *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 597-602 Sponsored in part by EEC (For primary document see N93-15718 05-18)
(BRITE Proj. P-2381-5)
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Updating dynamic finite element models within an industrial context requires not only an efficient and dependable algorithm but in addition a well adapted software code which can handle a large quantity of data coming from both experimental and finite element modal analyses. A finite element model updating technique under development shows promising initial results. The progression from simple simulated test cases to real complex structures led to a need to incorporate the updating method into a suitable software code. A theoretical description of the updating method is given and the software code is presented followed by a review of several applications. ESA

N93-15733# Southampton Univ. (England). Inst. of Sound and Vibration Research.
VIBRATION CHARACTERISATION FOR LOW LEVEL DISTURBANCES INDUCED IN TELECOMMUNICATIONS SPACECRAFT
N. S. Ferguson and D. C. G. Eaton (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 603-608 Sponsored by ESA/ESTEC (For primary document see N93-15718 05-18)
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In orbit low level vibrations induced by such sources as thrusters,

motors, reaction wheels, etc., may create problems for laser optics communications systems. As part of a larger overall program, investigations were conducted into such vibration transmission behaviors using available simple structures and components. The findings from these investigations are reviewed and frequency regimes where finite element or statistical energy analysis related tools can be applied and regions requiring further study are identified. ESA

N93-15734*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

PRACTICAL ASPECTS OF ON-ORBIT MODAL IDENTIFICATION USING FREE-DECAY DATA

Axel Schenk (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany) and Richard S. Pappa *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 609-617 (For primary document see N93-15718 05-18)

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Future large space structures such as Space Station Freedom can be tested as a total structure on Earth. Size, zero g design, and the existing atmosphere conflict with traditional structural dynamic testing. On-orbit modal identification will become necessary. Practical aspects of performing such tests using time domain analysis of free decay data are discussed. The effects of environmental constraints, structural characteristics, and excitation and sensing are reviewed. A recent laboratory application and sensing are reviewed. In this test, an on-orbit experiment is simulated using free decay data and a limited number of excitation and measurement points. The test article is dynamically similar to the truss/solar arrays of Space Station. The identified modal parameters from this simulation correlate well, though not uniquely, with those obtained in a complete modal survey. Practical difficulties in performing the correlation are illustrated. Model parameters are identified with the Eigensystem Realization Algorithm. ESA

N93-15735# LMS International, Leuven (Belgium).

EXCITATION VECTOR CONSIDERATIONS IN MULTIPLE SINUSOIDAL TESTING **c39**

D. Otte, J. Debille, W. Bakkers, and H. VanderAuweraer *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 619-623 (For primary document see N93-15718 05-18)

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Current modal test techniques based on multiple sinusoidal excitation are reviewed. Multiple input stepped sine testing is a phase separation technique. It consists of two steps: the estimation of frequency response functions, followed by modal parameter estimation. Multiple exciter normal mode testing is a phase resonance technique, where the structure is actually forced to vibrate as a pure normal mode. The aim is to review and investigate the forcing requirements for both approaches from a global point of view, and to present a new unifying approach combining several advantages of both. ESA

N93-15736# Southampton Univ. (England). Inst. of Sound and Vibration Research.

A STUDY OF HIGH FREQUENCY VIBRATIONS DUE TO PYROTECHNIC SHOCKS IN COUPLED SYSTEMS **c39**

D. Lednik and R. J. Pinnington *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 625-630 Sponsored by CNES and Aerospatiale (For primary document see N93-15718 05-18)

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A method of predicting the vibrational response of complex structures to shock inputs is currently being developed. The possibility of using a combination of two approximate approaches is being examined: wave propagation analysis (WPA) and transient statistical energy analysis (TSEA). Some results of a theoretical investigation into the transient power flow between coupled beams are presented. TSEA and WPA predictions seem to be in good agreement with exact results, virtually independent of the coupling strength. ESA

N93-15737# MATRA Espace, Toulouse (France).

CAD TO FEM TOOL **c61**

N. Jourdon, A. Mavrogenis, and M. Klein (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 633-639 (For primary document see N93-15718 05-18)

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A high level interactive software which derives automatically a FEM (Finite Element Method) for a CAD (Computer Aided Design) one is addressed. The process of conversion is divided into four parts: simplification phase, to suppress all nonpertinent mechanical components of CAD model; abstraction phase, to transform available components into simple meshable entities adapted to engineering approaches; assembly phase, to choose the assembly mode to adjust each abstracted element to one another; and transfer to the preprocessing of a finite element. ESA

N93-15738# Centre National d'Etudes Spatiales, Toulouse (France).

SIMULATION OF GEOMETRIC CONFIGURATIONS OF AN IN ORBIT SATELLITE [SIMULATION DES CONFIGURATIONS GEOMETRIQUES D'UN SATELLITE SUR ORBITE]

T. Figeac and J. L. LeGal *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 641-645 In FRENCH (For primary document see N93-15718 05-18)

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The design of space vehicles necessitates geometric configuration analysis and must address in particular problems of occultation and field of view. The CONFOR software, integrated with the EUCLID CAD (Computer Aided design) tool, simulated geometric configurations of in orbit satellites. The program configures the in orbit CAD model and calculates the ground tracks of the fields of view while taking account of the eventual occultations. Besides the fields of view calculation, this program provides explicit visualizations of satellites in orbit and helps identify, in particular, the different related shadows. ESA

N93-15739# Centre National d'Etudes Spatiales, Toulouse (France).

INTEGRATION OF CAD TOOLS IN SPACE VEHICLE DESIGN **c61**

J. L. LeGal *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 647-650 (For primary document see N93-15718 05-18)

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The research and development axes to integrate the different computer aided design (CAD) softwares are presented. The first investigations concern integration of engineering applications. Specific modules integrated in the EUCLID IS modeler, propose powerful interactive tools with the possibility of direct referencing of geometric models built in the design department. The second research axis deals with the exchange and archiving of CAD data. The capabilities of the SET standard are evaluated and CATIA and EUCLID interfaces are tested. All the archiving needs are analyzed and specific studies are initiated to develop a technical database consultation tool. ESA

N93-15740# Virginia Polytechnic Inst. and State Univ., Blacksburg. Materials Response Group.

MICROMECHANICAL CONCEPTS FOR THE ESTIMATION OF PROPERTY EVOLUTION AND REMAINING LIFE **c39**

Ken Reifsnider, Zhanjun Gao, and Rob Swain *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 653-658 (For primary document see N93-15718 05-18)

(Grant AF-AFOSR-0216-89)

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The position that micromechanical formulations, which include the properties, geometries, and arrangements of the constituents and interphases, are ideally suited for use as a basis for representations of strength at the micro and macro damage level is presented. Such formulations are argued to also be well suited for the discussion of changes in properties such as stiffness and strength that are brought about by microdamage processes during the service life of composite materials. The use of such property evolution calculations to estimate the remaining life of composite material systems subjected to sustained and cyclic mechanical, chemical, and thermal environments is discussed. Experimental evidence related to these topics is emphasized and examples are presented. ESA

N93-15741# Centre National d'Etudes Spatiales, Toulouse (France).

DAMAGE MECHANICS MODELISATION OF COMPOSITE STRUCTURES: A PHYSICAL APPROACH OF FAILURE **c24**

L. Perret, E. LeDantec (Bertin et Cie., Plaisir, France), and D. Engrand

(Bertin et Cie., Plaisir, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 659-664 (For primary document see N93-15718 05-18)
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Research to develop more phenomenological and predictive approaches to failure and damage of composite structures is addressed. The damage mechanics models used, the computational tools in development, and some applications illustrating the usefulness, accuracy, and adequacy to physical reality representation of such approaches are presented. ESA

N93-15742# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Strukturmechanik.
DAMAGE MECHANISMS AND CONSTITUTIVE RELATIONS FOR CRACKED UD-LAYERS IN CROSSPLY LAMINATES c24
H. Eggers and H. C. Goetting *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 665-669 (For primary document see N93-15718 05-18)
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Matrix splitting was studied for the inner 90 deg layers of crossply laminates. The rectangular specimens, fabricated with material T300/914C, were stressed by T fatigue loading (R = 0.1) in the 0 deg direction. The coordinates of the cracks were measured perpendicular to the fiber in dependence of stacking order, load level, and number of load cycles. Based on data of about 37,000 cracks, the spacings between adjacent cracks and between three consecutive cracks were analyzed. By tests and numerical analysis the forming of layer cracks and associated damage initiated at the surface of adjacent layers were studied. For multiple cracked 90 deg layers the tridimensional residual stiffness tensor was generated. ESA

N93-15743# Engineering System International, Rungis (France).
COMPOSITE MATERIAL DAMAGE AND FRACTURE MODELS FOR NUMERICAL SIMULATIONS IN SUPPORT OF FRACTURE CONTROL c24
A. deRouvray, E. Haug, and C. Stavrinidis *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 671-678 Sponsored in part by ESA/ESTEC (For primary document see N93-15718 05-18)
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A review of specifications applicable to the development and validation of sound predictive numerical material models for damage and fracture, to be used with finite element structural codes is conducted. Such approximate models, named engineering equations of state, are defined at the material local 'meso' scale, where the material description remains homogeneous. Key requirements are the following: intrinsic models and objective models. Validation should cover the following: scale and gradient effects, thickness effects, and arbitrary loading conditions. From this, validity ranges can be established. An example for the predictive simulation of the tensile strength of composite laminate notched test pieces, using a specialized nonlinear fracture mechanics finite element model (PAM-FISS/Bi-Phase) is described. Knocked down factors for the ligament strength are successfully predicted, up to 60percent strength reduction, for various specimens with different notches (from round holes to slits), sizes (ratios of 1 to 8), and stackups. ESA

N93-15744# Maschinenfabrik Augsburg-Nuernberg A.G., Augsburg (Germany).
ROLE OF COMBINED NUMERICAL AND EXPERIMENTAL INVESTIGATIONS IN THE JUSTIFICATION OF THE STRUCTURAL INTEGRITY AND DAMAGE TOLERANCE OF SPACE STRUCTURES
P. Agatonovic and M. Windisch *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 679-685 (For primary document see N93-15718 05-18)
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An overview of the methods applied to guarantee the structural integrity of Ariane 5 solid rocket motor cases is presented. A combined analytical, numerical, and experimental analysis was performed for the evaluation of crack driving parameters, critical crack size, etc. The complexity of this performance is given by the extreme ratio of cylinder diameter/wall thickness of the booster case segments in combination with the specified internal pressure during operation and proof/qualification loads which results in a nonlinear material behavior. The results show very good agreement with the experiments carried out on surface crack tensile specimens and ensure that the prediction shows no avoidable conservatism. ESA

N93-15745# Construcciones Aeronauticas S.A., Madrid (Spain). Space Div.
ISOSTATIC MOUNTING PLATFORM
F. Arevalo, A. Ayuso, E. Ozores, and A. Pradier (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 689-695 Sponsored by ESA/ESTEC (For primary document see N93-15718 05-18)
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Development in the isostatic mounting platform program is described. Optical communications in satellites and some other optical experiments require supporting platforms to attach highly precise and sensitive optical equipment. New concepts for the supporting platform have to be designed in accordance with very stringent requirements as follows: very high stiffness of the complete assembly (optical devices, platform, and supports) with a first natural frequency higher than 160 Hz; strong mechanical decoupling between the platform and the spacecraft containing it (isostatic concept); very low mass; very high dimensional stability in the order of 0.1 micrometers of deformation or 0.1 arc sec of rotation; and availability of a great number of hard points to attach different equipment placed in different configurations. ESA

N93-15746# Oerlikon-Contraves A.G., Zurich (Switzerland). Space Div.
INFLATABLE, SPACE-RIGIDIZED STRUCTURES: PROGRESS IN DESIGN, TECHNOLOGY AND VERIFICATION
Marco C. Bernasconi *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 697-701 (For primary document see N93-15718 05-18)
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The technology of inflatable, space rigidized reflectors has been applied mainly to offset antenna layouts. Progress in the design of on-axis reflectors is discussed, showing the conceptual flexibility of this approach and its capability to provide relatively large apertures from compact, self containing packages, as suitable for small size satellites. This realization is made possible by the adoption of a metallized torus external segment that provides an improved thermal conditioning with an acceptable small RF performance penalty. A simplified model for this estimation of the reflector accuracy is presented and its results are compared with empirical data. The proposed verification philosophy is outlined in conclusion. ESA

N93-15747# Construcciones Aeronauticas S.A., Madrid (Spain). Div. Espacio.
SERVICE MODULE STRUCTURE OF ISO SPACECRAFT TESTING AND DESIGN QUALIFICATION
M. Caldentey *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 703-708 (For primary document see N93-15718 05-18)
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The Infrared Space Observatory (ISO) spacecraft structure is composed of two main parts: the service module and the payload module. These components follow different qualification paths until the final integration and testing of the system. The service module structure was conceived as an independent subsystem with the simplest interface specification. The activities performed on the service module in the phase C/D, that permitted the qualification of the structure, and the corresponding design development that validates the structural concept of this subsystem, are presented. ESA

N93-15748# Oesterreichische Raumfahrt- und Systemtechnik, Vienna (Austria).
SUNSHADE SUPPORT STRUCTURE: STRUCTURE AND TESTING
Miroslav Hager *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 709-715 (For primary document see N93-15718 05-18)
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The results of sunshade support structure design, analyses, and testing are presented and the application and problems that motivated the proposed solution are explained. Description of the sunshade structure struts is given by detailing the design features and highlighting the way in which these

features meet the requirements. The role that the struts played in the overall spacecraft construction and the way in which the design and manufacture were tested, evaluated, and validated, are described. A comparison was made between such a strut and the woven strut with metal fittings designed and developed for the same ISO (Infrared Space Observatory) project (sunshield structure struts) with similar requirements. The resultant strut design and its actual performance data are presented.
ESA

N93-15749# Construcciones Aeronauticas S.A., Madrid (Spain). Div. Espacio.
POLAR PLATFORM STRUCTURE DEVELOPMENT PROGRAM
J. G. SanMartin and P. Luengo *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 717-721 (For primary document see N93-15718 05-18)
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The Polar Platform spacecraft is an Earth observation satellite, scheduled for launching and injection into its Sun synchronous orbit in 1997 by means of Ariane 5 launcher. The Polar Platform structure has large dimensions (more than 10 m total length), and it is a good example of future large structures which will be operative in orbit during the next decade. The main tasks performed up to now and those foreseen in the corresponding development program to define a suitable concept for this structure are presented.
ESA

N93-15750# Alenia Spazio S.p.A., Rome (Italy).
ACOUSTIC TESTS STRUCTURAL PREDICTIONS **c71**
C. Bruno and L. Scolamiero *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 725-729 (For primary document see N93-15718 05-18)
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Pressure environment in acoustic test chambers are quite complex and described in terms of mean values over specified frequency bands. The mechanical interaction between fluid and structure is assessed and finite element analysis applicability for the relevant structural dynamic response predictions is investigated. An input reduction method based on classical sine and random dynamic loading techniques is presented. Theoretical versus experimental results for large antenna reflector panels are also reported.
ESA

N93-15751# Construcciones Aeronauticas S.A., Madrid (Spain). Div. Espacio.
HISPASAT DBS REFLECTOR: MECHANICAL ANALYSIS-ENVIRONMENTAL TEST CORRELATION
R. Jimenez *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 731-735 (For primary document see N93-15718 05-18)
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The design of the complete DBS (Direct Broadcast System) antenna for the Spanish communication satellite HISPASAT was carried out taking as a reference the experience in previous programs. An overview of the development logic followed, the main design solutions taken, the test predictions, environmental tests results, and consequent correlations to demonstrate the fulfillment of the imposed specifications are outlined.
ESA

N93-15752# Maschinenfabrik Augsburg-Nuernberg A.G., Augsburg (Germany).
DEVELOPMENT, MANUFACTURING AND ALIGNMENT OF 2 m DIAMETER MIRROR FOR PRONAOS **c89**
F. Hofbauer, M. Duran (MATRA Espace, Toulouse, France), and Ph. Luquet (MATRA Espace, Toulouse, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 737-742 (For primary document see N93-15718 05-18)
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The application of carbon fiber reinforced plastic to the design and manufacturing of lightweight mirrors for the 2 m primary mirror of the telescope PRONAOS is illustrated. The telescope is to be used for the performance of balloon-borne infrared astronomy. Seven 60 deg segments for the primary mirror of the telescope, with a total accuracy of less than 3 micrometers rms were designed and manufactured. The final alignment of the mirror is also described.
ESA

N93-15753# Alenia Spazio S.p.A., Rome (Italy). Space Antenna Group.
A SYSTEMATIC APPROACH FOR THE DRSS IOL APM DESIGN
Alberto Meschini *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 743-746 (For primary document see N93-15718 05-18)
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A systematic approach for the definition and selection of the Data Relay System Satellite (DRSS) Inter Orbit Link (IOL) Antenna Pointing Mechanism (APM) is presented. The APM concept will allow the rotation of a large single offset reflector around the feed focus. Because of the severe requirements of such an APM design, it is of prime importance to consider the largest APM candidate configurations and hence to develop a method for defining and selecting the better solution. Three major APM families were identified and several example solutions are given. Taking into account the actual APM requirements, a rationale for the design parameters that could be considered in a tradeoff activity is presented.
ESA

N93-15754# Aerospatiale, Bordeaux (France).
DAMAGE TOLERANCE CHECKING ON Ni/H2 BATTERY CELLS **c33**
J. L. Dodelin, B. Journet (Aerospatiale, Suresnes, France), M. Kornmann (Battelle Europe, Geneva, Switzerland), D. Paugam (Societe des Accumulateurs Fixes et de Traction, Romainville, France), and L. Perret (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 749-753 (For primary document see N93-15718 05-18)
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The development of a range of nickel/hydrogen battery cells for an energy density of 50 to 60 Wh/kg is described. These cells contain high pressure hydrogen (up to 7.5 MPa) and are designed for manned applications (Columbus) as well as for geostationary satellites. Manned applications specifications require checking the damage tolerance capability of the cell (safe life and leak before burst). In order to comply with this requirement a wide range of coupon testings were untertaken. Major parameters such as hydrogen embrittlement of the Inconel wall under specific pressure and cycling frequency conditions were taken into account. Information on crack propagation rates under hydrogen pressure, showing the effects of cycling frequency and embrittlement inhibition by a KOH coating, was obtained.
ESA

N93-15755# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany).
CHARACTERIZATION OF Al 2219 MATERIAL FOR THE APPLICATION OF THE SPIN-FORMING-PROCESS **c31**
D. Mueller-Wiesner, E. Sieger (Zeppelin-Metallwerke G.m.b.H., Friedrichshafen, Germany), and K. Ernsberger (Fachhochschule, Weingarten, Germany) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 755-760 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H., Bremen, Germany (For primary document see N93-15718 05-18)
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The shells of the propellant tanks of the Ariane 5 EPS stage are to be manufactured by the spin forming process. The material for the shells (hemispheres) is the aluminum alloy 2219. By a material characterization program optimized parameters for the application of the forming process starting from different material conditions (T31 temper and '0' condition) are determined. Based on the results of this program it was decided to start spin forming in the '0' condition for flight hardware.
ESA

N93-15756# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).
FATIGUE CHARACTERIZATION OF Ni-BASE ALLOYS **c26**
G. Marci *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 761-768 (For primary document see N93-15718 05-18)
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Nickel base alloys are the main structural materials for turbine and rocket engines. Experimental work related to fatigue crack growth threshold and Delta K(sub eff) revealed that the Ni base alloys investigated behaved differently from other alloys in respect to the so called K(sub op). It was found that for Ni base alloys K(sub op) was always above K(sub min) for constant or slightly changing amplitude fatigue cycles. For the other materials

investigated it was found that K(sub op) is limited to approximately 70 percent of K(sub max) making cycles with R ratios higher than R approximately equal to 0.7 effective in their entirety. ESA

N93-15757# Maschinenfabrik Augsburg-Nuernberg A.G., Augsburg (Germany).
TESTING AND CHARACTERISATION OF METALLIC MATERIALS FOR STRUCTURAL ANALYSIS OF HIGH TEMPERATURE COMPONENTS **c39**
N. Taylor and P. Agatonovic *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 769-774 (For primary document see N93-15718 05-18)
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An advanced life prediction procedure for reliably transferring material properties evaluated on laboratory specimens to components operating at high temperatures is described. For this it is necessary to combine different kinds of testing for material characterization and damage evaluation with numerical calculations and computer support. On the basis of a comprehensive program of creep fatigue tests on Alloy 800H, a modified strain range partitioning life prediction method is proposed. To apply this to predict component life the stress-strain history at critical locations must be determined. This may be accomplished via finite element analysis using a viscoplastic material model established on the basis of appropriate tests. Simulation of component stress-strain histories in uniaxial laboratory specimens confirms the high accuracy of the developed life prediction method. ESA

N93-15758# Alenia Spazio S.p.A., Rome (Italy).
RESIDUAL STRESSES IN WELDS AND EFFECT ON CRACK GROWTH PREDICTION **c39**
Flavio Bandini *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 775-780 (For primary document see N93-15718 05-18)
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In an attempt to increase the reliability of the welding process and to save mass for future space programs (i.e. Spacelab, Columbus, Hermes), a study to investigate the influence of longitudinal residual stress due to welding processes on the propagation of a through crack located in the weld area was performed. In order to verify the software, a complete test program was executed to measure either welding residual stresses or propagation of cracks perpendicular to the weld. Test results and their assessment are presented and discussed. ESA

N93-15759# Dornier System G.m.b.H., Friedrichshafen (Germany).
A HIGH PRECISION SANDWICH REFLECTOR FOR FIRST: DESIGN AND MECHANICAL ANALYSIS OF THE SANDWICH CORE **c24**
Rudolf Sippel and Gunter Helwig *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 783-787 (For primary document see N93-15718 05-18)
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A thermostable full carbon fiber reinforced plastic sandwich shell was selected as a design concept for the large high precision antenna reflector of the FIRST (Far Infrared Space Telescope) project. Since no suitable ready core was available, a special core development program was started. During the core design phase, fiber and matrix type stacking sequences for the cell wall laminate and core cell shape were selected. For suitable analysis of thermal deformations, a three dimensional idealization is needed. In this idealization, the core is represented by orthotropic solid elements. A serious problem with this method is the calculation of the smeared core properties. A useful procedure was found in the past, but for the severe FIRST requirements the development of an improved method was necessary. The method was used for the selected core and its correct work was demonstrated by two checks. A sensitivity analysis showed that for the selected core some smeared properties are strongly dependent on face skin thickness and core height. ESA

N93-15760# Alenia Spazio S.p.A., Rome (Italy). Space Antenna Group.
ANALYSIS AND TEST METHODS FOR THE EVALUATION OF DEPLOYMENT SHOCK **c39**
William Adam, Alberto Bramante, and Alberto Meschini *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 789-792 (For primary document see N93-15718 05-18)
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Because of increasing payload dimensions, stability and subsequent deployment is of primary importance. On deployment, the payloads are subjected to shock. Especially during preliminary design phases, the prediction and understanding of shock related problems may be useful. A quick computational approach for reasonably predicting the shock levels and hence the maximum deployment rate allowable is presented. An experimental procedure was set up in order to verify this approach, and a case study for an antenna type structure is presented. ESA

N93-15761# Aerospatiale, Les Mureaux (France). Div. des Systemes Strategiques et Spatiaux.
TELECOM 2 DEPLOYABLE REFLECTORS **c32**
A. Noir, J. D. Lefebvre, and D. Coquelet (Bertin et Cie., Plaisir, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 793-798 (For primary document see N93-15718 05-18)
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The design, technology, performance, and status of development of TELECOM 2 deployable reflectors are presented. The two high gain C band and X band antennas of TELECOM 2 spacecraft use a 2200 mm diameter thin stiffened shell reflector with their associated mechanisms, which hold them stowed, release them, deploy them and latch them in their operational deployed configuration. The reflector and mechanisms assembly is now qualified. ESA

N93-15762# Southampton Univ. (England). Inst. of Sound and Vibration Research Consultancy Services.
ACOUSTICALLY INDUCED VIBRATION OF PLATFORM MOUNTED EQUIPMENT CONTAINING PRINTED CIRCUIT BOARDS **c39**
J. N. Pinder and D. C. G. Eaton (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 801-806 Sponsored by ESA/ESTEC (For primary document see N93-15718 05-18)
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Problems experienced during the development and qualification testing of equipment containing printed circuit boards, led to concern that such testing can be unduly severe when compared to the response behavior observed at the system level. Work which demonstrates that unit level tests are in fact likely to be unduly severe, in some frequency regions, is described and the insight into design and test guidance, which it is intended to introduce into ESA's structural acoustics design manual, is provided. The following features are outlined: the insensitivity of the equipment box to direct acoustic excitation; the response behavior of the platform and the mounted equipment to acoustic excitation; a comparison between the findings of the acoustic tests; and responses induced by unit level mechanical vibration testing. Supporting analytical investigations using finite element and statistical energy analysis are outlined. ESA

N93-15763# Aeronautical Research Inst. of Sweden, Bromma.
GENERALISED DAMPING IN FLUID STRUCTURE INTERACTION ANALYSES USING MODAL SYNTHESIS **c34**
Peter Goeransson and Jan Brandt *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 807-812 (For primary document see N93-15718 05-18)
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A discussion of generalized damping in fluid structure interaction analysis is presented. The term generalized damping refers in this context to non-proportional damping models, i.e. finite element damping matrices which are not possible to diagonalize with the undamped modes of the vibroacoustic system. Two different alternative approaches to reduce the final system of equations are discussed from a theoretical point of view, and one of them, involving free interface modal synthesis, is demonstrated in a simple one dimensional problem with an analytical solution available. This method is shown to be promising in terms of the calculated damped response of the structural part of the system. ESA

N93-15764# Construcciones Aeronauticas S.A., Madrid (Spain). Space Div.
EXPERIMENTAL APPROACH ON THE PYROTECHNICAL SHOCK REDUCTION OF ARIANE-5 UPPER STAGE **c15**

I. Uribarri, P. Tejero, B. Rivaillon (MATRA Espace, Toulouse, France), and B. Laviron (MATRA Espace, Toulouse, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 813-818 (For primary document see N93-15718 05-18)

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The separation of the upper stage of the Ariane 5 launcher is to be achieved by means of a Pyrotechnical Expansive Tube (PET) installed in the Vehicle Equipment Bay (VEB) structure. When the pyrotechnical device is activated, severe shock levels are transmitted to the structural components and electronic equipment located near the separation section. These shock inputs could affect the operational performances of the above mentioned components during and after separation. An experimental research project to verify that VEB equipment will not be damaged, to achieve a deeper knowledge of the nature and consequences of the event, and to improve existing theoretical models, was undertaken. A specification was identified for the equipment platform, and a campaign of technological tests were started in order to select a damping material and its layout to obtain the highest shock reduction without compromising the VEB structural integrity and stiffness. ESA

N93-15765# DNV Ingemansson A.B., Stockholm (Sweden).

POWER FLOW FINITE ELEMENT ANALYSIS FOR BEAMS AND PLATES **c39**

B. Klasen *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 819-823 (For primary document see N93-15718 05-18)

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A Power Flow Finite Element Method (PFFEM) for predicting high frequency response of complex structures where the ordinary FEM becomes impractical to use is presented. The formulation of power flow theory is shown to result in a partial differential equation similar to the equation governing heat conduction. The method is implemented into a commercial FE code and used to predict dynamic response of two application examples. The applications are a simply supported beam and a simply supported plate excited with a harmonically varying load at the center. ESA

N93-15766# Nova Scotia Technical Coll., Halifax. Dept. of Mechanical Engineering.

DEVELOPMENT OF A LASER-BASED MEASUREMENT SYSTEM FOR MODAL TESTING OF LARGE SPACE STRUCTURES **c36**

A. K. Mitchell, C. R. Hazell, and Y. Soucy (Canadian Space Agency, Ottawa, Ontario) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 827-831 (For primary document see N93-15718 05-18)

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Conventional modal testing methods using rigidly mounted accelerometers to obtain the response of vibrating structures are considered inappropriate for testing of large space structures because of inherent mass loading effects and insufficient sensitivity at very low frequencies. As a result, a noncontacting vibration measuring system was developed based on a commercially available single cnannel laser vibrometer. Using two acoustooptic modulators as very rapid switching devices, it is expected that the single channel system can be expanded to accomodate up to 50 channels of virtually simultaneous vibration data via time division multiplexing. The modulators are computer controlled and allow random or sequential access to each channel. A working 10 channel system was successfully demonstrated. ESA

N93-15767# DNV Ingemansson A.B., Stockholm (Sweden). Structural Dynamics Dept.

DEVELOPMENT OF A FORCE MEASUREMENT DEVICE **c35**

Otto Wilmar *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 833-838 (For primary document see N93-15718 05-18)

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The development of a Force Measurement Device (FMD) for recording interface forces between shaker table and Ariane 4 satellites is reported. The FMD is designed to measure forces and moments in the frequency range from 0.1 to 100 Hz with an accuracy better than 3 percent in basic modes up to 20 Hz, and 7 percent for higher modes. The ring shaped FMD concept contains 8 piezoelectronic force links and an analog electronic signal processing unit for reduction of the measured signals to 3 total forces and 3 moments. These are output to the test site signal analysis system. The required accuracy of the output and the structural safety of the device were verified by static tests. ESA

N93-15768# Construcciones Aeronauticas S.A., Madrid (Spain). Space Div.

ON THE DYNAMIC QUALIFICATION OF LARGE DEPLOYABLE ANTENNAS **c32**

Kimon Alexiou and Pedro Luengo *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 839-846 (For primary document see N93-15718 05-18)

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A review of published research and development work carried out with reference to emerging technologies is presented. In addition to large deployable antennas the review encompasses developments associated with large space structures in general. The design criteria of the next generation of large space deployed/erected structures such as deployable reflector antennas, space station and solar arrays are based on loads experienced during their in orbit operation, in zero g environments. The differences between service in orbit and Earth environments and the size, joint dependent, lightweight and high flexibility construction renders the ground based verification testing of these future structures inappropriate and/or problematic. ESA

N93-15769# Dornier System G.m.b.H., Friedrichshafen (Germany).

DEPLOYMENT ANALYSIS AND IN ORBIT CONTROL OF LARGE REFLECTORS

H. Baier, W. Charon, and B. Specht *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 849-853 (For primary document see N93-15718 05-18)

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Large reflectors have to be stowed for launch and are to be accurately deployed in orbit. Three different critical development aspects for a deployable reflector consisting of rigid panels are addressed: the reduction of launch loads by a conceptual vibration isolation system, the development and verification of the deployment process and mechanisms by analysis and tests, and the possibility of shape control by the application of piezoelectric materials. ESA

N93-15770# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Space Communications and Propulsion Systems Div.

DYNAMIC DEPLOYMENT ANALYSIS OF A MESH ANTENNA REFLECTOR **c32**

B. Groeger *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 855-860 (For primary document see N93-15718 05-18)

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Dynamic deployment analyses were performed on a reflector unfurlable mesh antenna using the multibody dynamic program DADS under three conditions: 0 g condition, 1 g condition with gravity compensation, and damage case under 0 g condition. Special restart techniques are applied to prevent excessive long computation times. ESA

N93-15771# Engineering System International, Rungis (France).

THE NUMERICAL SIMULATION OF THE INFLATION PROCESS OF SPACE RIGIDIZED ANTENNA STRUCTURES

E. Haug, J. B. Protard, G. Milcent, A. Herren (Oerlikon-Contraves A.G., Zurich, Switzerland), and O. Brunner (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 861-869 (For primary document see N93-15718 05-18)

Copyright Avail: CASI HC A02/MF A04

The inflation process of an Inflatable Space Rigidized Structure (ISRS) is unknown under space conditions and difficult, if not impossible, to verify experimentally in ground based tests. After some adaptations, the validated standard passenger safety airbag deployment options of the industrial explicit dynamic finite element code PAM-CRASH are applied in the numerical simulations of the two chamber antenna deployment. This could be done because the deployment process of an airbag for passenger safety in a motor vehicle and the deployment process of an ISRS bear many similitudes. The numerical methodology is demonstrated and validated on simple

benchmark tests for which ground based tests could be made. The methodology is applied to full two chamber antenna deployment. ESA

N93-15772# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

EQUATIONS OF MOTION OF MULTIBODY SYSTEMS IN THE ESA-MIDAS SOFTWARE **c61**

Duc Minh Tran *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 871-876 (For primary document see N93-15718 05-18)

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Two formalisms used in the ESA MIDAS software for deriving the equations of motion of multibody systems are presented. The elastic displacements of flexible bodies are represented by use of vibration modes and are assumed to be small and linear on the modal coordinates. In the first formalism, Lagrange's equations are written for each body in terms of nonholonomic velocities, the generalized coordinates being the absolute coordinates of the reference points, the absolute rotation angles of the body reference frames and the modal coordinates. In the second formalism, Kane's equations with multipliers are used, the generalized speeds are the derivatives of the free and prescribed rotations and translations in the joints and the derivatives of the modal coordinates. The simulations carried out on a three link manipulator show that Kane's method is more efficient than Lagrange's equations. ESA

N93-15773# Aerospatiale, Les Mureaux (France). Div. des Systemes Strategiques et Spatiaux.

DYNAMIC OF LARGE REFLECTORS **c32**

P. Picard, C. Dauviau, J. D. Lefebvre, C. Garnier (Aerospatiale, Cannes, France), and C. Truchi (Aerospatiale, Cannes, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 877-883 (For primary document see N93-15718 05-18)

Copyright Avail: CASI HC A02/MF A04

Work in the field of the unfurlable mesh reflectors as part of the dynamic of large reflectors project is presented. These studies use the unfurlable reflector design developed since 1983: gilded molybdenum reflective mesh supported by a deployable truss. From this strong background two specific critical points are studied: the deployment phase, where, for a deployment test, the test measurements are correlated with dynamic software predictions and the deployment bench chosen uses a 0 g compensation device by helium balloons; the antenna deployed configuration, where the interaction between a large structure and the attitude and orbit control subsystem is analyzed. ESA

N93-15774# Construcciones Aeronauticas S.A., Madrid (Spain). Space Div.

CFRP INTEGRAL END FITTING FOR HIGH STABILITY TRUSS STRUCTURES

A. Alonso and A. Cuadrado *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 887-892 (For primary document see N93-15718 05-18)

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High stability structures based on tubes to get a high stiffness and low coefficient of thermal expansion are penalized, both in mass and thermomechanical behavior, by connecting those tubes by means of metallic end fittings. A study aiming to develop a concept of CFRP (Carbon Fiber Reinforced Plastic) end fitting is presented. Different concepts for end fittings were evaluated. The key result was the end fitting geometry. Different possible geometries were found and computer aided design models constructed. One of those possible geometries was successfully manufactured and tested, measuring its stiffness and strength. ESA

N93-15775# Maschinenfabrik Augsburg-Nuernberg A.G., Augsburg (Germany).

ORFEUS CFRP STRUCTURE: A HIGH STIFFNESS-LOW THERMAL STRAIN SPACE TELESCOPE STRUCTURE **c89**

Thomas Schaeffler *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 893-899 (For primary document see N93-15718 05-18)

Copyright Avail: CASI HC A02/MF A04

ORFEUS (Orbiting and Retrievable Far and Extreme Ultraviolet Spectrometer) is a 1 m diameter telescope to be integrated into the ASTRO-SPAS satellite on one of its missions. ORFEUS is to be launched in 1992 for a 7 day mission on the Space Shuttle. Design constraints to be respected during the development of the tube shaped structure with 4 m length and 1.1 m inner diameter were: lowest coefficient of thermal expansion, high stiffness, low outgassing rates and low mass. These constraints led to a filament wound tube stiffened on the outer side with autoclave cured CFRP (Carbon Fiber Reinforced Plastic) profiles. Material used is a high modulus carbon fiber in combination with epoxy resin. Flanges and other interfaces are mainly made of a low coefficient of thermal expansion nickel iron alloy Invar. An Invar foil covers the inner surface of the tube to restrict outgassing. ESA

N93-15776# Construcciones Aeronauticas S.A., Madrid (Spain). Div. Espacio.

DESIGN OF JOINTS FOR DAMPED STRUCTURES **c39**

P. Luengo *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 901-906 Sponsored by ESA/ESTEC (For primary document see N93-15718 05-18)

Copyright Avail: CASI HC A02/MF A04

Local design of joints in truss type structures can improve the dynamic behavior of such structures. In particular the response under dynamic excitations can be reduced significantly maintaining the stiffness, strength and stability budgets under control. The design of a joint concept based on a fail safe approach which was tested under sinus and random environments, reducing the response of the structure without affecting the stiffness properties, is presented. ESA

N93-15777# Maschinenfabrik Augsburg-Nuernberg A.G., Augsburg (Germany).

EXPERIENCES WITH LARGE CFRP-RADIOTELESCOPE REFLECTORS **c32**

D. Muser *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 907-911 (For primary document see N93-15718 05-18)

Copyright Avail: CASI HC A01/MF A04

Since 1986 several ground based 15 m radiotelescopes with CFRP (Carbon Fiber Reinforced Plastic) structures and reflector panels are under operation in the millimeter wavelength range. A new submillimeter telescope with 10 m diameter is under manufacture. Analysis and design, manufacturing and qualification show the advantages of CFRP. While the assembled dishes have accuracies of some 50 micrometers rms the mean value of about 1000 panels was measured to 12 micrometer rms. These results show the possibilities of manufacturing large space based antennae with the required accuracies for millimeter and submillimeter operations. ESA

N93-15778# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.

DYNAMIC IDENTIFICATION IN THE DEVELOPMENT OF SATELLITE STRUCTURES. ANALYTICAL DYNAMIC MODEL UPDATING: THE CHALLENGE FOR THE NINETIES

S. R. Ibrahim *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 913-922 (For primary document see N93-15718 05-18)

Copyright Avail: CASI HC A02/MF A04

The development of an accurate mathematical model has become a key factor in mission success of space structures. The current state of the art in modeling of satellite and space structures is to use test and identification results to optimize an existing analytical model; mostly a finite element. The problems of error localization and of updating analytical models are defined, current and existing trends are discussed, limitations are highlighted, and needs are summarized. ESA

N93-15779# Dornier System G.m.b.H., Friedrichshafen (Germany).

STRUCTURE-ACOUSTIC FINITE ELEMENT ANALYSES FOR NOISE REDUCTION INVESTIGATIONS OF LAUNCHER PAYLOAD COMPARTMENT STRUCTURES MADE OF CFRP SANDWICH MATERIAL **c39**

M. Faust, G. Schweickert, and F. Strobel *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 925-931 (For primary document see N93-15718 05-18)

Copyright Avail: CASI HC A02/MF A04

An investigation of the noise reduction properties of the Ariane 5 Speltra

payload compartment structure is reported. The low frequency noise reduction was calculated by the Finite Element Method (FEM) with a formulation for fluid structure interaction (FE code PERMAS-FS). The results of the different analysis steps including uncoupled and coupled analysis are presented. The uncoupled structure and cavity dynamics results were compared to closed form solutions with good agreement. The introduction of external field effects, i.e. radiation damping and scattering, was performed by using closed form solutions for cylinder type structures. The analyses were performed for 2 different test cylinders and the Speltra cylindrical part. The test cylinder results were compared with the measured noise reductions and good agreement was obtained. ESA

N93-15780# METRAVIB, Lyon (France).
FLUID-STRUCTURE INTERACTION APPLIED TO THE ANALYSIS OF A TEST SANDWICH PANEL TYPICAL FOR SPATIAL APPLICATIONS c34
D. VaucherdelaCroix, L. Perret (Centre National d'Etudes Spatiales, Toulouse, France), and J. M. Parot (IMDYS, Brioude, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 933-937 Sponsored by CNES (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

A study to demonstrate the feasibility of an original method dedicated to fluid/structure interaction phenomena is presented. Based on the fact that the interaction is moderate, the proposed method consists of a time domain calculation coupling two independent kernels, a structural and an acoustical one, in an iterative scheme. The developed code, named ASTRYD-C, was applied to the response analysis of a test sandwich panel in air. Comparisons between numerical and experimental results for various configurations of this light structure, typical of space applications, show good agreement and demonstrate the ability of the proposed method to solve problems where coupling phenomena are significant. ESA

N93-15781# Sociedad de Investigacion, Estudios y Experimentacion S.A., Madrid (Spain).
MATHEMATICAL MODELLING OF PYROTECHNIC SHOCK IN THE ARIANE 5 VEB STRUCTURE c39
M. C. Huerta, E. Alarcon (Universidad Politecnica de Madrid, Spain), and S. Gomez-Lera (Universidad Politecnica de Madrid, Spain) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 939-944 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

The theoretical improvements performed since the last spacecraft and mechanical testing conference on the study of the pyrotechnic shock phenomena produced during the separation of the lower stage of the Ariane 5 Vehicle Equipment Bay (VEB) structure are described. The first theoretical approach used was based on the wave propagation method, including axial and shear waves. The method was changed, in order to capture the bending effects, as well as the influence of the frequency dependent damping values. In addition to the development of the theoretical method, efforts were made to improve the criteria used to model the structure. Comparison of the theoretical predictions with the test results of a flat test sample 1 m width, as well as a preliminary test performed on a small sample, are presented. ESA

N93-15782# Borello (G.), Sainte Jean-l'Union (France).
EFFECT OF THE PAYLOAD ON THE SURROUNDING INTERNAL ACOUSTIC ENVIRONMENT AT LIFT-OFF c71
G. Borello *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 945-948 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

A predictive limit can be fixed to the influence of payloads on the internal acoustic pressure at lift-off. For this purpose, the vibroacoustic interaction between the fairing, the acoustic cavity and the payload, is analyzed through global parameters: the absorption area of the fairing, which was determined by a specific test campaign on the Ariane 4 fairing in reverberant chamber; the absorption area of a set of payloads which were estimated using specific tests performed on two payloads. ESA

N93-15783# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany).
RECENT DEVELOPMENTS IN CONTROLLING A HYDRAULIC MULTI-AXIS TEST FACILITY c14
G. Lachenmayr *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 951-957 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

The demanded performance data of a hydraulic multi-axis test facility for space structures lead to a design of the hydraulic system using three stage servo valves for the actuators. These valves may cause problems of noise and harmonic distortion in service. An optimal overall control system for a hydraulic multi-axis test facility must be adapted to the test object and perhaps also to the loading time histories. This demands a simple and safe possibility of at least the adjustment of the controller parameters, which can be achieved by a digital control system much more easily than with an analog system. These topics were investigated in order to prepare the procurement of a hydraulic multi-axis test facility for aerospace testing. ESA

N93-15784# ISTAR, Plaisir (France).
CONTROL OF COMBINED VIBRATIONS AND MULTI-AXIS TEST c39
G. Catteau and C. Hutin *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 959-961 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

Environmental tests performed to control the behavior of equipment have necessitated requirements such as particular excitations mixing stationary and nonstationary signals and multi-axis excitations. The more common cases are: narrow bands of random swept on broadband random; sine signal swept on a broadband random; and gun fire. Sometimes different combinations of mixed signals have to be sent in several axes. The use of a numerical system facilitates the generation of these combinations but their control in closed loop is quite difficult. Indeed, random signals are processed using Fourier transform theory and an accurate analysis of sine signals or nonstationary signals requires completely different tools. A numerical vibration control system performing these tests is presented. The hardware set, the principles used for the software, some examples and results, and complementary possibilities are described. ESA

N93-15785*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GROUND TEST VALIDATION FOR PRECISION STRUCTURES c39
Ben K. Wada, John A. Garba, and James L. Fanson *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 963-967 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

Future proposed NASA missions will require large precision truss type structures that are deployed or assembled in space. To date, space structures that are important to missions success have been ground tested to validate their performance. Evaluation of the performance requirements of future systems has shown that using current and projected design and test approaches, the structure cannot be adequately validated by ground test. A problem exists since it is believed that unless important structure systems can be validated by ground tests, they will never be adopted for future missions. New design or ground test approaches are necessary to enable future missions. The inability of current approaches to validate future structural systems is discussed. ESA

N93-15786# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
THE USE OF REVERBERANT-ROOM ACOUSTIC TESTING FOR SPACECRAFT STRUCTURES AND THEIR PAYLOADS c71
D. C. G. Eaton, G. Boulked, and G. Paindessous *In its* Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 969-977 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

An account of a series of structural acoustics tests in the Large European Acoustic Facility (LEAF) and a summary of the main findings are presented. These investigations were part of the LEAF commissioning phase. Essentially, they provided a 'dress rehearsal' for the test facility operators prior to project use and enabled practical handling of structures, checking microphone and accelerometer systems and additional siren operation practice. It also provided an opportunity to investigate the acoustical properties of an Ariane fairing (half) enclosure and their impact on structural samples. The findings demonstrated the generally reverberant nature of

the enclosure and the rather small effect of local additional (reflecting) structural elements on specimen response behavior. ESA

N93-15787# Commissariat a l'Energie Atomique, Le Barp (France). Centre d'Etudes Scientifiques et Techniques d'Aquitane.
ENVIRONMENTAL TAILORING: A MAJOR PERSPECTIVE FOR MECHANICAL TESTING FOR FUTURE SPACE PROJECTS
C. Lalanne and J. F. Imbert (Intespace, Toulouse, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 979-984 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

Basic principles of the 'test tailoring' approach are presented with emphasis on mechanical environment. The four steps of life profile definition, collection of environment data, derivation of qualification test specification and test program definition, are described. Maxi-max response and fatigue damage equivalence criteria are reviewed. In the past few years this approach has not been widely used in industry because of a lack of adequate software tools. However this situation is rapidly changing. New generation software tools available for implementation are surveyed as well as data base organization. The applicability of test tailoring to space projects is analyzed. ESA

N93-15791*# Science Applications International Corp., Torrance, CA.
OUTLINE FOR REUSABLE REENTRY SATELLITE SYSTEM SPECIFICATION, VOLUMES 1 - VOLUME 9
Oct. 1989 54 p
(Contract NAS9-18202)
(NASA-CR-185958; NAS 1.26:185958; SAIC-RRS-011-Vol-1-9) Avail: CASI HC A04/MF A01

This document describes the outline proposed by the SAIC team for the RRS System Specification document. This document will be updated periodically during the course of the study, providing design insights and information pertinent to the various elements of the RRS design. The RRS System Specification document organization is shown schematically. The RRS Vehicle (RRV), Payload Module (PM), and the Operations Support (OS) are the three main segments of the overall system for which formal interface control will exist. The number and relationship of these interface specifications to the main segments is also shown. Author

N93-15803*# Eagle Engineering, Inc., Houston, TX.
REUSABLE REENTRY SATELLITE (RRS): LAUNCH TRADEOFF STUDY Summary Report
Mar. 1990 74 p Prepared for Science Applications International Corp., Torrance, CA
(Contract NAS9-18202)
(NASA-CR-186395; NAS 1.26:186395; RRS-021) Avail: CASI HC A04/MF A01

A goal of the Phase B study is to define the launch system interfaces for the reusable reentry satellite (RRS) program. The focus of the launch tradeoff study, documented in this report, is to determine which expendable launch vehicles (ELV's) are best suited for the RRS application by understanding the impact of all viable launch systems on RRS design and operation. Author

N93-15804*# Science Applications International Corp., Torrance, CA.
REUSABLE REENTRY SATELLITE (RRS): CONFIGURATION TRADE STUDY Summary Report
Dec. 1990 51 p
(Contract NAS9-18202)
(NASA-CR-187772; NAS 1.26:187772; RRS-042) Avail: CASI HC A04/MF A01

The overall Reusable Reentry Satellite (RRS) Phase B Study objective is to design a relatively inexpensive satellite to access space for extended periods of time, with eventual recovery of experiments on Earth. The expected principal use for such a system is research on the effects of variable gravity (0-1.5 g) and radiation on small animals, plants, lower life forms, tissue samples, and materials processes. The RRS will be capable of: (1) being launched by a variety of expendable launch vehicles; (2) operating in low earth orbit as a free flying unmanned laboratory; and (3) executing independent atmospheric reentry and soft landing. The RRS will be designed to be refurbished and reused up to three times a year for a period of 10 years. The information provided in this report describes the process involved in the evolution of the RRS overall configuration. This process considered reentry aerodynamics, aerothermodynamics, internal equipment layout, and vehicle mass properties. This report delineates the baseline design decisions that were used to initiate the RRS design effort. As a result, there will be deviations between this report and the RRS Final Report. In those instances, the RRS Final Report shall be considered to be the definitive reference. Author

N93-15805*# Science Applications International Corp., Torrance, CA.
EXPERIMENT MODULE/SUPPORT MODULE INTERFACE SPECIFICATION FOR THE REUSABLE REENTRY SATELLITE
Feb. 1991 23 p
(Contract NAS9-18202)
(NASA-CR-187885; NAS 1.26:187885; RRS-IFS-201; SAIC-RRS-045)
Avail: CASI HC A03/MF A01

This Interface Specification (IFS) identifies, defines, and controls the interface between the Reusable Reentry Satellite (RRS) Vehicle (RRV) Experiment Module (EM) and the Support Module (SM) equipment. Contained in this specification are the physical, functional, and environmental interface requirements for the SM and EM. This specification is tailored to the unique requirements of the EM associated with the Rodent Module. The addenda to this specification contain the requirements for alternate EM's. Author

N93-15847# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A MODAL ANALYSIS AND MODELLING OF A LIGHTLY DAMPED LARGE SPACE STRUCTURE M.S. Thesis
Scott E. George Jun. 1992 186 p
(AD-A256566; AFIT/GA/ENY/92J-01) Avail: CASI HC A09/MF A02

This study involves the modification to the PACOSS Dynamic Test Article to create a lightly damped representative large space structure with closely spaced, low frequency modes. An experimental modal analysis is performed to recharacterize the low frequency flexible vibration modes. A finite element model is created using MSC/NASTRAN to predict low frequency behavior using both real eigenvalue analysis and frequency response analysis. Then a reduced order model is created and fine-tuned to represent the dynamics of the structure for the identified low frequency modes. GRA

N93-15872# Boston Coll., Chestnut Hill, MA. Inst. for Space Research.
CRRES TIME HISTORY DATA BASE DEVELOPMENT FOR THE HIGH ENERGY ELECTRON FLUXMETER, MEDIUM ENERGY ELECTRON SPECTROMETER, ELECTRON AND PROTON ANGLE SPECTROMETER, AND PROTON TELESCOPE Scientific Report No. 2
Dennis E. Delorey 31 May 1992 26 p
(Contract F19628-90-K-0028)
(AD-A256179; BC-ISR-92-002; PL-TR-92-2139; AD-E201177) Avail: CASI HC A03/MF A01

The Combined Release and Radiation Effects Satellite (CRRES) payload included a number of instruments designed to provide data on particles, fields, and waves. The Time History Data Base (THDB) for the CRRES mission provides the data source for short time duration event studies as well as long term efforts involving statistical analyses and modelling efforts. Prime uses for the THDB include the development of the static radiation belt model and cosmic ray model. This study defines the analysis procedures and the instrument THDB file formats for each experiment. GRA

N93-15977# Naval Postgraduate School, Monterey, CA. Dept. of Operations Research.
PACISM: A DESIGN AID FOR THE DEVELOPMENT OF THE PETITE AMATEUR NAVY SATELLITE
Russell Gottfried and Michael Bailey 2 Sep. 1992 17 p
(AD-A256719; NPS-OR-92-015) Avail: CASI HC A03/MF A01

In this work, we describe the features and use of PACISM, a simulation model used to support satellite design decisions during the construction of PANSAT, the Petite Amateur Navy Satellite, at the Naval Postgraduate School. The model features communications modeling at the packet level, an accurate portrayal of the store-and-forward mechanism the satellite employs, satellite footprint movement over the earth's surface, and bit error generation, detection, and correction. We describe the object-oriented design of the model, as well as how it is being used by engineers to

support decisions about the equipment used in the satellite, the way the equipment will be employed, the way we control the user population, and methods to keep control of the satellite. GRA

N93-16027# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.
ABLATIVE THERMAL PROTECTION STRUCTURE DESIGN OF BALLISTIC REENTRY SPACECRAFT
Chen Qinghua 8 Oct. 1992 14 p Transl. into ENGLISH from unidentified Chinese language document p 44-48
(AD-A256908; FASTC-ID(RS)T-0623-92) Avail: CASI HC A03/MF A01

The paper presents the ablative thermal protection structure design of a ballistic reentry spacecraft. The concepts, material selection, design approach, analytical computation and evaluation are described. GRA

N93-16112# Phillips Lab., Kirtland AFB, NM.
TRADE-OFFS IN MASS AND EFFECTIVENESS IN SATELLITE SHIELDING: A DESIGN APPROACH Final Report, 24 May - 31 Dec. 1991
Bryan H. Fortson Aug. 1992 29 p
(AF Proj. 3763)
(AD-A256693; AD-E201184; PL-TR-92-1020) Avail: CASI HC A03/MF A01

The optimal design for a debris shield for a spacecraft is discussed. A shield 3-ft thick would provide excellent protection, but would be prohibitively expensive to deploy. Conversely, using no shield at all would be highly economical, but would provide poor protection from impacts. Somewhere between these two extremes is a shielding design that combines effectiveness with practicality. A rationale for determining this optimal configuration is outlined. Consider the case for which the thickness of a shield determines its mass and its debris-stopping effectiveness. A shield is considered to have failed when its ballistic limit is exceeded, that is, when it is penetrated. Using this criterion, along with existing models of the orbital debris environment, computer simulations can determine the probability that a given shield will be penetrated by debris over a 1-yr time span. This probability can be expressed as a function of the shield thickness. The shield thickness corresponding to the maximum acceptable probability of failure is the optimum thickness. An experimental plan is outlined for applying this rationale. GRA

N93-16539 Colorado Univ., Boulder.
APPLIED, THEORETICAL MODELING OF SPACE-BASED ASSEMBLY, USING EXPERT SYSTEM ARCHITECTURE FOR COMPUTER-AIDED ENGINEERING TOOL DEVELOPMENT Ph.D. Thesis
Steven Douglas Jolly 1992 669 p
Avail: Univ. Microfilms Order No. DA9232699

The challenges associated with constructing interplanetary spacecraft and space platforms in low earth orbit are such that it is imperative that comprehensive, preliminary process planning analyses be completed before committing funds for Phase B design (detail design, development). Phase A and 'pre-Phase A' design activities will commonly address engineering questions such as mission-design structural integrity, attitude control, thermal control, etc. But the questions of constructability, maintainability and reliability during the assembly phase usually go unaddressed until the more mature stages of design (or very often production) are reached. This is an unacceptable strategy for future space missions whether they be government or commercial ventures. After interviews with expert Aerospace and Construction industry planners a new methodology was formulated and a Blackboard Metaphor Knowledge-based Expert System synthesis model has been successfully developed which can decompose interplanetary vehicles into deliverable orbital subassemblies. Constraint propagation, including launch vehicle payload shroud envelope, is accomplished with heuristic and numerical algorithms including a unique adaptation of a reasoning technique used by Stanford researchers in terrestrial automated process planning. The model is a hybrid combination of rule and frame-based representations, designed to integrate into a Computer-Aided Engineering (CAE) environment. Emphasis is placed on the actual joining, rendezvous, and refueling of the orbiting, dynamic spacecraft. Significant results of this new methodology upon a large Mars interplanetary spacecraft (736,000 kg) designed by Boeing, show high correlation to manual decomposition and planning analysis studies, but at a fraction of the time, and with little user interaction. Such Computer-Aided Engineering (CAE) tools would greatly leverage the designers ability to assess constructability. Dissert. Abstr.

N93-16615*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN OPTIMIZATION-BASED INTEGRATED CONTROLS-STRUCTURES DESIGN METHODOLOGY FOR FLEXIBLE SPACE STRUCTURES
Peiman G. Maghami, Suresh M. Joshi, and Ernest S. Armstrong Jan. 1993 46 p
(RTOP 590-14-51-01)
(NASA-TP-3283; L-17080; NAS 1.60:3283) Avail: CASI HC A03/MF A01

An approach for an optimization-based integrated controls-structures design is presented for a class of flexible spacecraft that require fine attitude pointing and vibration suppression. The integrated design problem is posed in the form of simultaneous optimization of both structural and control design variables. The approach is demonstrated by application to the integrated design of a generic space platform and to a model of a ground-based flexible structure. The numerical results obtained indicate that the integrated design approach can yield spacecraft designs that have substantially superior performance over a conventional design wherein the structural and control designs are performed sequentially. For example, a 40-percent reduction in the pointing error is observed along with a slight reduction in mass, or an almost twofold increase in the controlled performance is indicated with more than a 5-percent reduction in the overall mass of the spacecraft (a reduction of hundreds of kilograms). Author

N93-16661*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
CALIBRATION OF THE ARONSON 6-DOF ROBOTIC PLATFORM
Amy Y. Lin Aug. 1991 62 p
(Grant NAGw-1333)
(NASA-CR-191856; NAS 1.26:191856; CIRSSE-102) Avail: CASI HC A04/MF A01

A discussion is presented of the calibration of the Aronson six-degree-of-freedom platform. Absolute encoders are used to determine the starting positions of all six joints. The hardware implemented are described in detail. Software programs are used to calibrate the hardware and to build the look-up tables that are needed in determining the initial joint positions. The descriptions of all software routines used are given. Author

N93-16719*# Science Applications International Corp., Torrance, CA. Thermal Sciences Div.
REUSABLE REENTRY SATELLITE (RRS): THERMAL CONTROL TRADE STUDY Summary Report
Clark Wallace Apr. 1990 44 p
(Contract NAS9-18202)
(NASA-CR-186528; NAS 1.26:186528; RRS-027) Avail: CASI HC A03/MF A01

The design and assessment work performed in defining the on-orbit Thermal Control Subsystem (TCS) requirements for the Reusable Reentry Satellite (RRS) is discussed. Specifically, it describes the hardware and design measures necessary for maintaining the Payload Module (PM) Environmental Control Life Support System (ECLSS) heat exchanger, the hydrazine propellant, and PM water supply within their required temperature limits. Author

N93-16720*# Science Applications International Corp., Torrance, CA.
REUSABLE REENTRY SATELLITE (RRS): PROPULSION SYSTEM TRADE STUDY Summary Report
Apr. 1990 35 p
(Contract NAS9-18202)
(NASA-CR-186527; NAS 1.26:186527; RRS-026) Avail: CASI HC A03/MF A01

The purpose of the Reusable Reentry Satellite (RRS) Propulsion System Trade Study described in this summary report was to investigate various propulsion options available for incorporation on the RRS and to select the option best suited for RRS application. The design requirements for the RRS propulsion system were driven by the total impulse requirements necessary to operate within the performance envelope specified in the

RRS System Requirements Documents. These requirements were incorporated within the Design Reference Missions (DRM's) identified for use in this and other subsystem trade studies. This study investigated the following propulsion systems: solid rocket, monopropellant, bipropellant (monomethyl hydrazine and nitrogen tetroxide or MMH/NTO), dual-mode bipropellant (hydrazine and nitrogen tetroxide or N2H4/NTO), liquid oxygen and liquid hydrogen (LO2/LH2), and an advanced design propulsion system using SDI-developed components. A liquid monopropellant blowdown propulsion system was found to be best suited for meeting the RRS requirements and is recommended as the baseline system. This system was chosen because it is the simplest of all investigated, has the fewest components, and is the most cost effective. The monopropellant system meets all RRS performance requirements and has the capability to provide a very accurate deorbit burn which minimizes reentry dispersions. In addition, no new hardware qualification is required for a monopropellant system. Although the bipropellant systems offered some weight savings capability for missions requiring large deorbit velocities, the advantage of a lower mass system only applies if the total vehicle design can be reduced to allow a cheaper launch vehicle to be used. At the time of this trade study, the overall RRS weight budget and launch vehicle selection were not being driven by the propulsion system selection. Thus, the added cost and complexity of more advanced systems did not warrant application. Author

N93-17061*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

PRESSURE WALL PATCH Patent Application

Joel E. Williamsen, inventor (to NASA) and Bruce Weddendorf, inventor (to NASA) 15 Oct. 1992 15 p

(NASA-Case-MFS-28724-1; NAS 1.71:MFS-28724-1; US-Patent-Appl-SN-961293) Avail: CASI HC A03/MF A01

A rigid patch body for placing over a damaged portion (hole) of an external wall of a pressurized vessel, such as a space vehicle or a habitat, is discussed. The rigid patch body allows an astronaut to make temporary repairs to the pressurized vessel from the exterior of the vessel, which enables more permanent repairs to be made from the interior of the vessel. The pressure wall patch of the present invention includes a floor surrounded by four side members. Each side member includes a threaded screw for anchoring the patch body to the external wall of the pressurized vessel and a recess in its lower surface for supporting an inflatable bladder for surrounding the damaged portion (hole) of the external wall to seal the area surrounding the damaged portion. This allows the vessel to be repressurized. The floor of the rigid patch body supports a source of gas that is connected to the gas supply valve and a gas supply gauge in communication with the gas supply valve and the inflatable bladder. NASA

N93-17537# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

SPACECRAFT SUSTAINED LOAD FRACTURE CONTROL

R. J. H. Wanhill 5 Mar. 1991 12 p Presented at International Conference on Spacecraft Structures and Mechanical Testing, Noordwjik, Netherlands, Apr. 1991

(NLR-TP-91093-U; ETN-92-92517) Avail: CASI HC A03/MF A01

A comprehensive sustained load fracture control plan, to be applied to manned spacecraft and orbital stations, is presented. Four types of sustained load fractures are considered: stress corrosion cracking, hydrogen embrittlement, liquid metal embrittlement, and solid metal embrittlement. Guidelines for obtaining and using sustained load test data for damage tolerance design with high strength metallic materials is reviewed, with the emphasis on small scale laboratory testing. Both fracture mechanics and non-fracture mechanics test methods are included. How fracture mechanics may be used as part of an overall strategy to present control sustained load fracture in service is indicated. The interactions between sustained load fracture and fatigue are discussed. ESA

N93-17539# National Aerospace Lab., Amsterdam (Netherlands). Space Div.

CONTROL LAW SYNTHESIS FOR LARGE FLEXIBLE SPACECRAFT

P. T. L. M. vanWoerkom 15 Apr. 1991 55 p Presented at Dutch Graduate School of Systems and Control Summer School Presentation on Control of Mechanical Systems, Zeist, Netherlands, 3-7 Jun. 1991

(NLR-TP-91155-U; ETN-92-92521) Avail: CASI HC A04/MF A01

The control of spacecraft displaying non-negligible interaction between control and structural deformation is discussed. The earliest experiences with performance degradation due to control/structure interaction are recalled. The interaction problem is schematized in terms of spillover between design model and residual model of the spacecraft dynamics. Robust control for spacecraft stabilization is described, as well as control for spacecraft performance. The latter may induce instability, and therefore robustness enhancement is called for. Various alternative approaches are outlined. Modifications of mechanical system properties as well as of control algorithms will be with the designer well into the spacecraft's active life. Therefore, continued end to end simulations involving updated truth models and updated control algorithms are required for continued and successful confrontation with physical reality. ESA

N93-17629# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Space Communications and Propulsion Systems Div.

ROSAT IN-ORBIT ATTITUDE MEASUREMENT RECOVERY

L. Kaffer, A. Boeinghoff, E. Bruederle, W. Schrempp, and P. Wullstein 1992 17 p Presented at 15th Annual American Astronautical Society Guidance and Control Conference, Keystone, CO, 8-12 Feb. 1992; sponsored by AAS Rocky Mountain Section

(MBB-UK-0168-92-PUB; ETN-92-92741; AAS-92-075) Avail: CASI HC A03/MF A01

After about 7 months of nearly perfect Attitude Measurement and Control System (AMCS) functioning, the ROSAT mission was influenced by gyro degradations which complicated the operation and after one year the nominal mission could no longer be maintained. The reestablishment of the nominal mission by the redesign of the attitude measurement using inertial reference generation from coarse Sun sensor and magnetometer together with a new star acquisition procedure is described. This success was only possible because sufficient reprogramming provisions in the onboard computer were available. The new software now occupies nearly the complete Random Access Memory (RAM) area and increases the computation time from about 50 msec to 300 msec per 1 sec cycle. This proves that deficiencies of the hardware can be overcome by a more intelligent software. ESA

N93-17719# Naval Postgraduate School, Monterey, CA.

THE DESIGN OF AN ADAPTIVE ATTITUDE CONTROL SYSTEM M.S. Thesis

Nicholas F. Russo Sep. 1992 91 p

(AD-A257632) Avail: CASI HC A05/MF A01

This research designed and simulated an adaptive attitude control system for the Crew Equipment/Retriever (CER) during autonomous attitude hold and large angle or slewing maneuvers. The CER is a proposed space robot that deploys from the Space Station and retrieves any lost equipment or incapacitated astronauts. The moment of inertia tensor for the CER and acquired target is not known a priori. In this research, the moment of inertia tensor is estimated by a Kalman filter and used to update the derived linear quadratic regulator (LQR) and quaternion feedback regulator (QFR) control laws. Computer simulation results show that during attitude hold the adaptive LQR design stabilizes the CER and provides a more fuel efficient controller effort: as compared with a previously designed nonadaptive minimum time controller and a nonadaptive LQR design. Computer simulation results of slewing maneuvers show that the adaptive QFR design provides a more fuel efficient controller: as compared with a nonadaptive QFR design. GRA

N93-17720# Naval Postgraduate School, Monterey, CA.

STRUCTURAL DESIGN, ANALYSIS, AND MODAL TESTING OF THE PETITE AMATEUR NAVY SATELLITE (PANSAT)

Daniel J. Sakoda Sep. 1992 89 p

(AD-A257633) Avail: CASI HC A05/MF A01

The Naval Postgraduate School's (NPS) Space Systems Academic Group is developing the Petite Amateur Navy Satellite (PANSAT), a small satellite for digital store-and-forward communication in the amateur frequency band. PANSAT is intended to be a payload of opportunity amendable to a number of launch vehicles. The Shuttle Small Self-Contained Payload (SSCP) program was chosen as a design baseline because of its high margins of safety as a manned system. The PANSAT structure design is presented for the launch requirements of a Shuttle SSCP. A finite element model was developed and studied for the design loads of a SSCP. The results showed the structure to be very robust and likely to accommodate the

requirements of other launch vehicles. The finite element analysis was verified by model testing, correlating the fundamental mode of the finite element model with that of an engineering test structure. GRA

N93-17769# Naval Postgraduate School, Monterey, CA.
APPLICATIONS OF THE PETITE AMATEUR NAVY SATELLITE (PANSAT) M.S. Thesis
Robert A. Payne, Jr. Sep. 1992 100 p
(AD-A258015) Avail: CASI HC A05/MF A02

This thesis provides an analysis of potential Petite Amateur Navy Satellite (PANSAT) system users. At a point in time where large satellite designers are just now beginning to focus their efforts towards capturing a portion of the rapidly expanding light satellite (lightsat) market, the Naval Postgraduate School is designing a lightsat unlike any which has been built before or will be built in the foreseeable future. A single PANSAT (or an entire constellation) can be lofted into orbit at a relatively low cost as a secondary payload on a variety of launch vehicles. Its design makes it an ideal system for providing store and forward communications to a large number of users at a fraction of the cost of most (if not all other) satellite systems. The long-term success of this program relies not only on the technical aspects of design and production but also on the Naval Postgraduate School's ability to create a satellite system that provides maximum utility to potential user communities yet to be explicitly defined. GRA

N93-17771*# Spaceborn, Inc., La Canada, CA.
ERROR DETECTION AND CORRECTION UNIT WITH BUILT-IN SELF-TEST CAPABILITY FOR SPACECRAFT APPLICATIONS Final Report
Constantin Timoc Jun. 1990 104 p
(Contract NAS7-1028; SBIR-06.11-0126)
(NASA-CR-190847; NAS 1.26:190847) Avail: CASI HC A06/MF A02

The objective of this project was to research and develop a 32-bit single chip Error Detection and Correction unit capable of correcting all single bit errors and detecting all double bit errors in the memory systems of a spacecraft. We designed the 32-bit EDAC (Error Detection and Correction unit) based on a modified Hamming code and according to the design specifications and performance requirements. We constructed a laboratory prototype (breadboard) which was converted into a fault simulator. The correctness of the design was verified on the breadboard using an exhaustive set of test cases. A logic diagram of the EDAC was delivered to JPL Section 514 on 4 Oct. 1988. Author

N93-16776*# College of William and Mary, Williamsburg, VA. Dept. of Mathematics.
THE DAMPER PLACEMENT PROBLEM FOR LARGE FLEXIBLE SPACE STRUCTURES
Rex K. Kincaid *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 133-135 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16896*# Construction Technology Labs., Skokie, IL.
CONCRETE: POTENTIAL MATERIAL FOR SPACE STATION
T. D. Lin *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 259-266 (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

N93-16915*# California Univ., San Diego, La Jolla. California Space Inst.
TETHERS
Andrew Hall Cutler and Joseph A. Carroll *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 136-150 (For primary document see N93-16905 05-91)
Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

N93-17323*# Alabama Univ., Tuscaloosa. Dept. of Industrial Engineering.
EMERGENCY EGRESS REQUIREMENTS FOR CAUTION AND WARNING, LOGISTICS, MAINTENANCE, AND ASSEMBLY STAGE MB-6 OF SPACE STATION FREEDOM
Paul S. Ray *In its* 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N93-15700# Arnold Engineering Development Center, Arnold AFS, TN.
THE AlCl ABSORPTION FEATURE IN SOLID ROCKET PLUME RADIATION Report, Oct. 1991 - Jul. 1992
W. K. McGregor, J. A. Drakes, K. S. Beale, and F. G. Sherrell Jul. 1992 8 p Previously announced in IAA as A92-47890
(AD-A256645; AIAA Paper 92-2917; ARO-28912.2-EG) Avail: CASI HC A02/MF A01

A phenomenon observed during plume diagnostic measurements acquired during simulated altitude chamber tests of aluminum-loaded solid-propellant rocket motors is discussed, and analytical results are presented. The results of a line-by-line calculation of the aluminum chloride (AlCl) feature are discussed and compared with high resolution ultraviolet (UV) spectral data. GRA

N93-15702# Arnold Engineering Development Center, Arnold AFS, TN.
ANALYSIS OF THE AlCl ABSORPTION FEATURE AND THE SEARCHLIGHT EMISSION EFFECT OBSERVED IN SOLID PROPELLANT ROCKET PLUMES Final Report, 19 Feb. 1991 - 30 Sep. 1992
Oliver S. McGregor, W. K. Reed, R. A. Drakes, J. A. Beale, and K. S. Sherrell Sep. 1992 43 p
(Contract MIPR-131-91)
(AD-A256784; AEDC-TR-92-12; ARO-28912.3-EG-SDI) Avail: CASI HC A03/MF A01

Two phenomena observed during plume diagnostic measurements acquired during simulated altitude chamber tests of aluminum-loaded solid-propellant rocket motors are discussed, and analytical results are presented. The results of a line-by-line calculation of the aluminum chloride (AlCl) feature are discussed and compared with high-resolution ultraviolet (UV) spectral data. Selected plume radiation measurements are reviewed, and evidence of searchlight emission is presented. Two searchlight modeling techniques are demonstrated and compared with motor test data. GRA

N93-15838# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
A PROBABILISTIC METHOD TO ESTABLISH THE RELIABILITY OF CARBON-CARBON ROCKET MOTOR NOZZLES. VOLUME 2: RELIABILITY AND FAILURE ANALYSES OF 2-D CARBON-CARBON STRUCTURAL COMPONENTS Technical Report, 1 May 1987 - 30 Jun. 1991
R. A. Heller, I. Yeo, and S. Thangjitham Apr. 1992 138 p
(Contract F04611-87-K-0010)
(AD-A257460; PL-TR-91-3068-Vol-2; AD-E201041) Avail: CASI HC A07/MF A02

The strength of brittle materials is characterized by a wide scatter. Such materials are also afflicted by size effects. Size effects in brittle composite structures such as beams and plates with and without stress

raisers are investigated experimentally and analytically. A methodology for reliability analysis of carbon-carbon composites is presented. The model is based on Weibull statistics which was extended to account for the three-dimensional stress field including interlaminar stresses. Failure criteria for bi-directional orthotropic lamina are developed and failure analysis in the non-probabilistic sense (i.e., first-ply-failure analysis) is performed. Comparisons are made with existing failure criteria, with the results of the reliability analysis and also with experiments. GRA

N93-16010# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
A PROBABILISTIC METHOD TO ESTABLISH THE RELIABILITY OF CARBON-CARBON ROCKET MOTOR NOZZLES. VOLUME 1: EXPERIMENTAL DETERMINATION OF MECHANICAL PROPERTIES FOR A CARBON-CARBON COMPOSITE Final Report, 1 May 1987 - 30 Jun. 1991
R. A. Heller, S. Thangjitham, T. Rantis, and T. G. Heller Apr. 1992 76 p
(Contract F04611-87-K-0010)
(AD-A257459; PL-TR-91-3068-Vol-1; AD-E201040) Avail: CASI HC A05/MF A01

Mechanical property characterization experiments were carried out on a 2-D, woven, carbon-carbon composite. These were followed by tests to determine statistical variability and size effects. Tension, compression, in plane and interlaminar shear tests, unnotched and notched four point beam and plate (with and without holes) tests were performed. Weibull distribution parameters are reported. GRA

N93-16015# Arnold Engineering Development Center, Arnold AFS, TN.
ANALYSIS OF THE AICI ABSORPTION FEATURE AND THE SEARCHLIGHT EMISSION EFFECT OBSERVED IN SOLID-PROPELLANT ROCKET PLUMES Final Report, Oct. 1991 - Jul. 1992
S. M. Oliver, W. K. McGregor, R. A. Reed, J. A. Drakes, and K. Beale Sep. 1992 43 p
(AD-A256176; AEDC-TR-92-12) Avail: CASI HC A03/MF A01

Two phenomena observed during plume diagnostic measurements acquired during simulated altitude chamber tests of aluminum-loaded solid-propellant rocket motors are discussed, and analytical results are presented. The results of a line-by-line calculation of the aluminum chloride (AICl) feature are discussed and compared with high-resolution ultraviolet (UV) spectral data. Selected plume radiation measurements are reviewed, and evidence of searchlight emission is presented. Two searchlight modeling techniques are demonstrated and compared with motor test data. GRA

N93-16131# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
A PROBABILISTIC METHOD TO ESTABLISH THE RELIABILITY OF CARBON-CARBON ROCKET MOTOR NOZZLES. VOLUME 3: STRESS AND RELIABILITY ANALYSIS OF LAYERED COMPOSITE CYLINDERS UNDER THERMAL SHOCK Final Report, 1987 - Sep 1991
R. A. Heller, S. Thangjitham, and X. Wang Apr. 1992 72 p
(Contract F04611-87-K-0010)
(AD-A257461; PL-TR-91-3068-Vol-3; AD-E201042) Avail: CASI HC A04/MF A01

The state of stress in a cylindrical structure consisting of multiple layers of carbon-carbon composite and subjected to thermal and pressure shock are analyzed using an elasticity approach. The reliability of the structure based on the weakest link concept and the Weibull distribution is also calculated. Coupled thermo-elasticity is first assumed and is shown to be unnecessary for the material considered. The effects of external and internal thermal shock as well as a superimposed pressure shock are examined. It is shown that for the geometry chosen, the structure may fail when exposed to thermal shock alone while a superimposed pressure shock can mitigate the probability of failure. GRA

N93-16177# Pacific Northwest Lab., Richland, WA.
ADVANCED HYBRID NUCLEAR PROPULSION MARS MISSION PERFORMANCE ENHANCEMENT
J. E. Dagle, K. E. Noffsinger, and D. R. Segna Feb. 1992 4 p Presented at the American Nuclear Society Meeting, Jackson Hole, WY, 16-19 Aug. 1992
(Contract DE-AC06-76RL-01830)
(DE93-001309; PNL-SA-20523; CONF-9208114-4) Avail: CASI HC A01/MF A01

Nuclear electric propulsion (NEP), compared with chemical and nuclear thermal propulsion (NTP), can effectively deliver the same mass to Mars using much less propellant, consequently requiring less mass delivered to Earth orbit. The lower thrust of NEP requires a spiral trajectory near planetary bodies, which significantly increases the travel time. Although the total travel time is long, the portion of the flight time spent during interplanetary transfer is shorter, because the vehicle is thrusting for much longer periods of time. This has led to the supposition that NEP, although very attractive for cargo missions, is not suitable for piloted missions to Mars. However, with the application of a hybrid approach to propulsion, the benefits of NEP can be utilized while drastically reducing the overall travel time required. Development of a dual-mode system, which utilizes high-thrust NTP to propel the spacecraft from the planetary gravitational influence and low-thrust NEP to accelerate in interplanetary space, eliminates the spiral trajectory and results in a much faster transit time than could be obtained by either NEP or NTP alone. This results in a mission profile with a lower initial mass in low Earth orbit. In addition, the propulsion system would have the capability to provide electrical power for mission applications. DOE

N93-16428*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
THEORY AND COMPUTATION OF OPTIMAL LOW- AND MEDIUM-THRUST TRANSFERS Semiannual Status Report, 7 Jul. 1992 - 6 Jan. 1993
C.-H. Chuang 5 Jan. 1993 34 p
(Grant NAG8-921)
(NASA-CR-191651; NAS 1.26:191651) Avail: CASI HC A03/MF A01

This report presents the formulation of the optimal low- and medium-thrust orbit transfer control problem and methods for numerical solution of the problem. The problem formulation is for final mass maximization and allows for second-harmonic oblateness, atmospheric drag, and three-dimensional, non-coplanar, non-aligned elliptic terminal orbits. We setup some examples to demonstrate the ability of two indirect methods to solve the resulting TPBVP's. The methods demonstrated are the multiple-point shooting method as formulated in H. J. Oberle's subroutine BOUNDSCO, and the minimizing boundary-condition method (MBCM). We find that although both methods can converge solutions, there are trade-offs to using either method. BOUNDSCO has very poor convergence for guesses that do not exhibit the correct switching structure. MBCM, however, converges for a wider range of guesses. However, BOUNDSCO's multi-point structure allows more freedom in quesses by increasing the node points as opposed to only quessing the initial state in MBCM. Finally, we note an additional drawback for BOUNDSCO: the routine does not supply information to the users routines for switching function polarity but only the location of a preset number of switching points. Author

N93-16541*# United Technologies Corp., Windsor Locks, CT. Space and Sea Systems Dept.
SPE PROPULSION ELECTROLYZER FOR NASA'S INTEGRATED PROPULSION TEST ARTICLE Final Report, Nov. 1988 - Aug. 1991
Aug. 1991 142 p Original contains color illustrations
(Contract NAS9-18030)
(NASA-CR-185669; NAS 1.26:185669; IPTA-007-91) Avail: CASI HC A07/MF A02; 12 functional color pages

Hamilton Standard has delivered a 3000 PSI SPE Propulsion Electrolyzer Stack and Special Test Fixture to the NASA Lyndon B. Johnson Space Center (JSC) Integrated Propulsion Test Article (IPTA) program in June 1990, per contract NAS9-18030. This prototype unit demonstrates the feasibility of SPE-high pressure water electrolysis for future space applications such as Space Station propulsion and Lunar/Mars energy storage. The SPE-Propulsion Electrolyzer has met or exceeded all IPTA program goals. It continues to function as the primary hydrogen and oxygen source for the IPTA test bed at the NASA/JSC Propulsion and Power Division Thermochemical Test Branch. Author

N93-16605*# Aerojet-General Corp., Sacramento, CA. Propulsion Div.
ASRM CASE INSULATION DESIGN AND DEVELOPMENT
Matthew S. Bell and William F. S. Tam 30 Oct. 1992 14 p Presented at the Society for the Advancement of Materials and Process Engineering,

Anaheim, CA, 10-13 May 1993
(Contract NAS8-37800)
(NASA-CR-191947; NAS 1.26:191947) Avail: CASI HC A03/MF A01

This paper describes the achievements made on the Advanced Solid Rocket Motor (ASRM) case insulation design and development program. The ASRM case insulation system described herein protects the metal case and joints from direct radiation and hot gas impingement. Critical failure of solid rocket systems is often traceable to failure of the insulation design. The wide ranging accomplishments included the development of a nonasbestos insulation material for ASRM that replaced the existing Redesigned Solid Rocket Motor (RSRM) asbestos-filled nitrile butadiene rubber (NBR) along with a performance gain of 300 pounds, and improved reliability of all the insulation joint designs, i.e., segmented case joint, case-to-nozzle and case-to-igniter joint. The insulation process development program included the internal stripwinding process. This process advancement allowed Aerojet to match to exceed the capability of other propulsion companies. Author

N93-16626*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.

MULTIMEGAWATT DYNAMIC NEP PMAD STUDY

Kenneth J. Metcalf Nov. 1992 8 p Presented at the 10th Symposium on Space Nuclear Power and Propulsion, Albuquerque, NM, 10-14 Jan. 1993
(Contract NAS3-25808)
(NASA-CR-190764; NAS 1.26:190764) Avail: CASI HC A02/MF A01

The National Aeronautics and Space Administration Lewis Research Center (NASA LeRC) is developing a FORTRAN-based model of a complete nuclear electric propulsion (NEP) vehicle to be used for piloted or cargo missions to the Moon or Mars. The proposed vehicle will use either a Brayton or K-Rankine power conversion cycle, and either ion or magnetoplasmadynamic (MPD) thrusters. In support of this effort, Rocketdyne evaluated various power management and distribution (PMAD) approaches and selected a low-frequency design that is based on the direct use of the alternator voltage and frequency for power transmission. This approach was compared with dc and high-frequency ac designs, and selected on the basis of mass, efficiency, and qualitative assessment of power quality, reliability and development costs. This low-frequency architecture will be used as the reference in future NEP PMAD studies and for the subsequent FORTRAN model development. Author

N93-16697*# Aerojet-General Corp., Sacramento, CA. Propulsion Div.

FORMED PLATELET COMBUSTOR LINER CONSTRUCTION FEASIBILITY, PHASE A Final Report

W. A. Hayes and D. E. Janke 30 Sep. 1992 169 p
(Contract NAS8-37456)
(NASA-CR-184506; NAS 1.26:184506; RPT/G0114.119) Avail: CASI HC A08/MF A02

Environments generated in high pressure liquid rocket engines impose severe requirements on regeneratively cooled combustor liners. Liners fabricated for use in high chamber pressures using conventional processes suffer from limitations that can impair operational cycle life and can adversely affect wall compatibility. Chamber liners fabricated using formed platelet technology provide an alternative to conventional regeneratively cooled liners (an alternative that has many attractive benefits). A formed platelet liner is made from a stacked assembly of platelets with channel features. The assembly is diffusion bonded into a flat panel and then three-dimensionally formed into a section of a chamber. Platelet technology permits the liner to have very precisely controlled and thin hot gas walls and therefore increased heat transfer efficiency. Further cooling efficiencies can be obtained through enhanced design flexibility. These advantages translate into increased cycle life and enhanced wall compatibility. The increased heat transfer efficiency can alternately be used to increase engine performance or turbopump life as a result of pressure drop reductions within the regeneratively cooled liner. Other benefits can be obtained by varying the materials of construction within the platelet liner to enhance material compatibility with operating environment or with adjoining components. Manufacturing cost savings are an additional benefit of a formed platelet liner. This is because of reduced touch labor and reduced schedule when compared to conventional methods of manufacture. The formed platelet technology is not only compatible with current state-of-the art combustion chamber structural support and manifolding schemes, it is also an enabling technology that allows the use of other high performance and potentially low cost methods of construction for the entire combustion chamber assembly. The contract under which this report is submitted contains three phases: (1) phase A - feasibility study and technology development; (2) phase B - sub-scale fabrication feasibility; and (3) phase C - large scale fabrication validation. This report covers the Phase A activities, which began in December of 1988. Author

N93-16714*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

PERFORMANCE COMPARISON OF AXISYMMETRIC AND THREE-DIMENSIONAL HYDROGEN FILM COOLANT INJECTION IN A 110N HYDROGEN/OXYGEN ROCKET

Lynn A. Arrington (Sverdrup Technology, Inc., Brook Park, OH.) and Brian D. Reed Dec. 1992 22 p Presented at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE Previously announced in IAA as A92-54027
(RTOP 506-42-31)
(NASA-TM-105967; E-7490; NAS 1.15:105967; AIAA Paper 92-3390)
Avail: CASI HC A03/MF A01

An experimental performance comparison of two geometrically different fuel film coolant injection sleeves was conducted on a 110 N gaseous hydrogen/oxygen rocket. One sleeve had slots milled axially down the walls and the other had a smooth surface to give axisymmetric flow. The comparison was made to investigate a conclusion in an earlier study that attributed a performance underprediction to a symplifying modeling assumption of axisymmetric fuel film flow. The smooth sleeve had higher overall performance at one film coolant percentage and approximately the same or slightly better at another. The study showed that the lack of modeling of three-dimensional effects was not the cause of the performance underprediction as speculated in earlier analytical studies. Author

N93-16722*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.

STUDY OF BASIC PHYSICAL PROCESSES IN LIQUID ROCKET ENGINES Final Report, 23 Feb. 1990 - 21 Feb. 1992

S. T. Wu and C. P. Chen Sep. 1992 50 p
(Contract NAS8-36955)
(NASA-CR-184481; NAS 1.26:184481) Avail: CASI HC A03/MF A01

Inconsistencies between analytical results and measurements for liquid rocket thrust chamber performance, which escape suitable explanations, have motivated the examination of the basic phys ical modeling formulations as to their unlimited application. The publication of Prof. D. Straub's book, 'Thermofluid-dynamics of Optimized Rocket Propulsions,' further stimulated the interest of understanding the gas dynamic relationships in chemically reacting mixtures. A review of other concepts proposed by Falk-Ruppel (Gibbsian Thermodynamics), Straub (Alternative Theory, AT), Prigogine (Non-Equilibrium Thermodynamics), Boltzmann (Kinetic Theory), and Truesdell (Rational Mechanism) has been made to obtain a better understanding of the Navier-Stokes equation, which is now used extensively for chemically reacting flow treatment in combustion chambers. In addition to the study of the different concepts, two workshops were conducted to clarify some of the issues. The first workshop centered on Falk-Ruppel's new 'dynamics' concept, while the second one concentrated on Straub's AT. In this report brief summaries of the reviewed philosophies are presented and compared with the classical Navier-Stokes formulation in a tabular arrangement. Also the highlights of both workshops are addressed. Author

N93-16754# RAND Corp., Santa Monica, CA.

POWER SYSTEMS FOR SPACE EXPLORATION

Calvin Shipbaugh and Kenneth A. Solomon 1992 12 p
(RAND-P-7768) Avail: CASI HC A03/MF A01

The Outreach Program was designed to solicit creative ideas from academia, research institutions, private enterprises, and the general public and is intended to be helpful in defining promising technical areas and program paths for more detailed study. To the Outreach Program, a number of power system concepts were proposed. In conclusion, there are a number of advanced concepts for space power and propulsion sources that deserve study if we want to expand our ability to not only explore space, but to utilize it. Advanced nuclear concepts and power beaming concepts are two areas worthy of detailed assessments. I.I.C.

N93-17363# Pacific Northwest Lab., Richland, WA.
POWER BEAMING PROVIDING A SPACE POWER INFRASTRUCTURE
J. A. Bamberger and E. P. Coomes Aug. 1992 7 p Presented at the 27th Intersociety Energy Conversion Engineering Conference, San Diego, CA, 3-7 Aug. 1992
(Contract DE-AC06-76RL-01830)
(DE93-000850; PNL-SA-20751; CONF-920801-26) Avail: CASI HC A02/MF A01

This study, based on two levels of technology, applies the power beaming concept to four planned satellite constellations. The analysis shows that with currently available technology, power beaming can provide mass savings to constellations in orbits ranging from low earth orbit to geosynchronous orbit. Two constellations, space surveillance and tracking system and space based radar, can be supported with current technology. The other two constellations, space-based laser array and boost surveillance and tracking system, will require power and transmission system improvements before their breakeven specific mass is achieved. A doubling of SP-100 conversion efficiency from 10 to 20 percent would meet or exceed breakeven for these constellations. DOE

N93-17607# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Panel.
AIRBREATHING PROPULSION FOR MISSILES AND PROJECTILES [PROPULSION AEROBIE DES MISSILES ET PROJECTILES]
Sep. 1992 217 p In ENGLISH and FRENCH Presented at the Propulsion and Energetics Panel 79th Symposium, Villepreux, France, 11-15 May 1992
(AGARD-CP-526; ISBN-92-835-0685-5) Copyright Avail: CASI HC A10/MF A03

The Conference Proceedings contains 15 papers and a Keynote Address presented at the Propulsion and Energetics Panel 79th Symposium on 'Airbreathing Propulsion for Missiles and Projectiles' which was held 11-15 May 1992 in Villepreux, France. The Symposium was arranged in the following sessions: Ramjets and Ramrockets: Survey papers; Ramjets and Ram Rockets: Propulsion Systems; Ramjets and Ram Rockets: Combustion, Fuels, Materials; Projectile Airbreathing Propulsion; Aerodynamics and Engine Integration; Turbojets and Turborockets; and Common Techniques. The Technical Evaluation Report is included at the beginning of the Proceedings. Questions and answers of the discussions follow some of the papers. Nineteen additional classified papers will be published in a classified volume. The Symposium was intended to be a forum for discussing advances made in this field since the conduct of a similar Symposium in the autumn of 1981. For individual titles, see N93-17608 through N93-17622.

N93-17608# Aerospatiale, Chatillon (France).
RAMJET PROPULSION FOR MISSILES IN THE MACH 3 TO 4.5 RANGE [PROPULSION PAR STATOREACTEUR POUR MISSILES DANS LE DOMAINE MACH 3 A 4,5]
Jean-Marie Laurent and Pascal Garnero *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 9 p In FRENCH (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A02/MF A03

New requirements that call for increases in range and improved penetration ability have forced the newest generation of missiles to fly higher and faster. Ramjet propulsion lends itself well to these requirements. However, the most recent technical specifications are very demanding when compared to those that were required of the first generation of missiles. The following topics are presented: air intakes; fuels; thermal protection of the combustion chamber; and forecasting and testing facilities. The technologies necessary for the production of missiles capable of speeds in the Mach 3-4.5 range exist, but the costs of these technologies must be reduced in order to facilitate the development of such missiles.
Transl. by FLS

N93-17609# Defence Research Agency, Farnborough (England). Air Vehicle Performance Dept.
POTENTIAL MISSILE FLIGHT PERFORMANCE GAINS FROM IMPROVEMENTS TO THE PROPULSION SYSTEM
M. S. Ivey and R. K. Oldham *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 14 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

Future developments in the propulsion of ramjet powered missiles will aim to widen the launch envelope, extend the operating range, and lengthen the period of powered flight to give a more potent terminal maneuver phase. In this paper, some of the possible methods of achieving these aims were critically assessed for typical stand-off and air-to-air missiles. For both types of missile, the use of a high density fuel for the main propellant would produce quite significant performance gains. However, storage and plume visibility problems have to be overcome. Gains can also be made for both missiles by optimizing the relative amounts of boost and main propellant to match the required launch envelope. The benefits of inlet and exhaust variability were explored for the stand-off missile. The latter option is the more favorable prospect for range enhancement, but the design of a low pressure loss variable mechanism will be difficult. The range of the air-to-air missile depends primarily on its launch Mach number and the range can be further increased by using a highly lofted trajectory with an unpowered terminal phase. The maximum and minimum fuel flow rates needed for this missile are related to the altitude limits of its flight envelope. Author

N93-17610# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
DEVELOPMENT TESTING OF THROTTLEABLE DUCTED ROCKETS
Hans-Ludwig Besser *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 13 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

Throttleability, being a current requirement for modern air-breathing missile propulsion systems, adds considerable complexity to the development of ducted rockets. Problems are especially inherent in the development of the following: (1) pressure sensitive propellants; (2) hot gas valves (especially for particle laden flow); and (3) ramcombustors featuring high performance over widely varying operating conditions. The use of propellant ingredients with high heating value but unfavorable combustion characteristics, like boron, is an additional challenge in the development of high energy ducted rocket systems. Extensive testing and a well conceived test philosophy are needed to achieve satisfactory development results. MBB, together with its subsidiary Bayern-Chemie, has been engaged in the field of throttleable ducted rockets for more than a decade. This paper summarizes test procedures which were established to address the strongly interrelated development problems and presents examples of test results derived from the development of a ducted rocket engine for a supersonic antiship missile. Author

N93-17611# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
THE DUAL COMBUSTOR RAMJET: A VERSATILE PROPULSION SYSTEM FOR HYPERSONIC TACTICAL MISSILE APPLICATIONS
Paul J. Waltrup *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 11 p (For primary document see N93-17607 05-20)
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Procedures for designing and maximizing the performance of Dual Combustor Ramjet (DCR) engines and vehicles powered by this engine are presented. Comparisons of DCR powered vehicles with scramjet powered vehicles for Mach 4 to 8 flight show that the DCR provides better performance at the Mach 4 flight condition, while the scramjet is better at Mach 8. Comparisons of the DCR with a ramjet for Mach 3 to 6 flight, with both having the same, but low, thrust level at Mach 3, show that the DCR exhibits better performance at and near the cruise condition at Mach 6 and similar performance during acceleration. Suggested additional comparisons to broaden the scope of the conclusions are also given.
Author

N93-17612# Centre de Recherches du Bouchet, Vert de Petit (France). SNPE, Defense/Espace.
SEMI-PROPELLANTS FOR DUCTED ROCKETS [SEMI-PROPERGOLS POUR STATOFUSEE] **c28**
B Mahe, C. Perut, C. Vigot (Centre d'Etudes et de Recherches, Toulon, France), and C. Masson (Centre d'Etudes et de Recherches, Toulon, France) *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 17 p In FRENCH (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

The purpose of this paper is to describe the different families of fuel-rich

solid propellants studied and developed at SNPE and ONERA for ducted rocket applications. These propellants are adjusted for choked gas generator or for unchoked gas generator configurations. They are ordered in three classes depending on their optical signature characteristics and their energetic performance: (1) smokeless propellants without metal; (2) reduced smoke compositions with a low rate of metals for a 'rustique' ducted rocket; and (3) high energy propellants with a high rate of particles--magnesium, carbon, and boron. Major properties of various fuel-rich solid propellants of each family are described. Author

N93-17613# Centre National de la Recherche Scientifique, Paris (France). Ecole Centrale Paris.

COMBUSTION INSTABILITIES IN A SIDE-DUMP MODEL RAMJET COMBUSTOR **c07**

J. M. Samaniego, B. Yip, T. Poinsot, and S. Candel *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 17 p (For primary document see N93-17607 05-20)

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Combustion instabilities are often observed in coaxial and side-dump combustors and can be detrimental to their performance. This study is aimed at identifying the physical mechanisms underlying combustion instabilities in these geometries. Recent studies performed on side-dump geometries have focused on hydrodynamic instabilities under non-reacting conditions. The present work was conducted on a two-dimensional two-inlet side-dump combustor, fed with a premixture of air and propane in order to examine reacting flow instabilities. Results from a stable combustion regime are presented in order to provide a basis for comparison with a low-frequency instability mode (520 Hz) which occurs at other combustor operating conditions. The flowfield structure is investigated using high speed Schlieren visualization and conditional C2 imaging. Simultaneous pressure, inlet velocity, and global C2 emission measurements are used to investigate the nature of the instability. Different processes involved in the instability mode are identified such as the acoustics of the combustor, the oscillatory motion of the jets underlying periodic jet-on-jet impingement and a complex behavior of the reaction zones. Furthermore, by obtaining an experimental local Rayleigh index distribution, it has been possible to identify the driving mechanisms of this instability. Author

N93-17614# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.

EXPERIMENTAL ANALYSIS OF COMBUSTION OSCILLATIONS WITH REFERENCE TO RAMJET PROPULSION **c25**

M. N. R. Nina and G. P. A. Pita *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 8 p (For primary document see N93-17607 05-20)

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The influences of flow rate, fuel air ratio, and bluff body geometry on the predominant frequencies of combustion-driven oscillations were measured in a tube and disc combustor. Small shifts in major frequencies were observed for different stabilizer geometries. By changing mass flow rate and at high velocities by changing the F/A ratio, discrete jumps in the frequency of large amplitude oscillations were produced in some of the configurations. Measurements of the wall pressure oscillations amplitude along the cold duct, upstream from the flameholder, confirm the presence of an acoustic three quarter wave. Changes in the cold cut length implies a difference in the main frequency of the pressure oscillations spectrum that was found to agree with the difference between two acoustic 3/4 waves corresponding to the two tube lengths. Author

N93-17615# Rheinmetall G.m.b.H., Duesseldorf (Germany).

RAMJET PROPULSION FOR ADVANCED PROJECTILES **c07**

R. Moenig and M. Moll *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 9 p (For primary document see N93-17607 05-20)

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The increasing effectiveness of future defense systems will lead to projectiles with extremely high impact energy, reduced flight times, and extended ranges. Gun launched projectiles using ramjet propulsion, show promising capabilities in weight, cost, and hit accuracy. If high maximum range and low crosswind sensitivity of projectiles is of primary interest, a compensation of drag can be obtained by ramjet propulsion at low fuel-to-air ratio. Moreover, with respect to applications against armored vehicles ramjet engines operating at nearly stoichiometric conditions, can be even used to increase the kinetic energy of KE-rods. The first part of the paper gives a survey on the main design objectives of ram-propulsion for projectile applications. A detailed theoretical analysis of advantages and limitations is presented for high performance ramjets. The second part deals with ramjet applications for artillery, air defense, and anti-armor weapons. Due to the high initial velocity provided by guns, ram-propulsion proves to be a very promising and efficient tool in order to meet the demands of future defense systems. Author

N93-17616# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

COMPARISON OF PERFORMANCES OF DIFFERENT CIRCULAR INTAKES **c07**

Hermann L. Weinreich and Klaus Treisch (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Berlin, Germany) *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 8 p (For primary document see N93-17607 05-20)

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Different circular front intakes with shock on lip Mach numbers ranging from 4.5-5.57 were investigated at DLR-Cologne and MBB under funding of the German MOD. The closeable front intake concept (born in 1985) offers high performance at Mach 3.6 transition in combination with exceptionally low drag during boost and cruise. Starting of the essential internal supersonic compression process could be achieved during initial centerbody translation at limited internal contraction and small capture area. A variety of corresponding Hy X intake models having different shock on lip Mach numbers, cowl angles, internal contractions, internal area distributions, and cowl lip bluntness data were tested between Mach 3.5 and 4.5 and gave experience on starting phenomena and performance. Fixed geometry intakes with external compression and quite different cowl angles (RH3A with cylindrical cowl, RH3C with large cowl angle) exhibited comparable or even better total pressure recoveries. The supercritical pre-entry drag characteristics below shock on lip Mach numbers however look most unfavorable. Without consideration of incidence characteristics and the problems associated with closure of intake entrance area during boost, the RH3A-intake could be used instead of the Hy X-type intake for medium range air to ground missiles. The RH3C-intake offers the highest value of total pressure recovery due to maximum external compression and proper cowl alignment. The corresponding high wave drag however prohibits any useful application of this type of intake. Author

N93-17617# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

MULTIPLE-INLET CONFIGURATION FOR MISSILES WITH SKID-TO-TURN CONTROL MODE **c08**

W.-D. Pohl and E.-O. Krohn (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Berlin, Germany) *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 13 p (For primary document see N93-17607 05-20)

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For missiles with cartesian control mode a symmetrical configuration with four inlets is most common. The operation of a multiple inlet system is significantly influenced by the interaction of the coupled inlets. Inherent problems are discussed by means of a simplified model and windtunnel test results. First a configuration with four axisymmetrical inlets is presented. Different inlet geometries and the influence of an external boundary layer bleed are investigated in order to obtain an enlarged stable operation regime. Windtunnel tests of individual inlets and of four coupled inlets showed the effects of inlet matching and the resulting overall performance. Furthermore a configuration with four rectangular inlets is discussed. Problems and advantages of the conventional and the inverted integration mode are illustrated using wind tunnel test results. It is shown that the use of a pre-compression ramp is especially beneficial to the inlet matching of four inverted inlets. Author

N93-17618# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Aircraft Div.

AERODYNAMIC ENGINE/AIRFRAME INTEGRATION FOR HIGH PERFORMANCE AIRCRAFT AND MISSILES **c05**

P. W. Sacher and W. Schmidt *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 21 p (For primary document see N93-17607 05-20)

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This paper is a FDP contribution to the 79th symposium on 'Airbreathing Propulsion for Missiles and Projectiles' being held from 11-15 May 1992 in St. Medard-en-Jalles, Bordeaux, France. It presents an overview of the main findings of the last FDP meeting during 7-15 Oct. 1991 in Fort Worth, TX, USA on the subject of the title of this review paper. The meeting was structured in six sessions, one of them having been organized and chaired in form of an invited session by PEP contributions. Each session will be reviewed separately in this paper and conclusions (in some cases recommendations for future AGARD activities) are made based on the major outcome of the sessions including contributions and comments from the auditorium after the presentations or from the closing Round-Table-Discussion at the end of the meeting. It has been clearly demonstrated that the subject of the symposium is a highly interdisciplinary effort, which overlaps the terms of reference of both AGARD Panels, FDP and PEP to a large extent. This is specifically true for major components of the propulsion system like the air intake and the nozzle. Both experimental and computational techniques for analysis and design used during the engine/airframe integration for all kinds of flight vehicles have been reported. Author

N93-17619# Naval Air Warfare Center, Trenton, NJ. Aircraft Div.
DEVELOPMENT AND QUALIFICATION OF THE US CRUISE MISSILE PROPULSION SYSTEM
William H. Reardon and Anthony J. Cifone *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 15 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

This paper provides a description of the very successful Cruise Missile gas turbine propulsion program managed by the United States Department of Defense. The paper contains a summary of the procurement process, the technical and programmatic milestones, issues and challenges, and lessons learned. In the past fifteen years, testing at the Naval Air Propulsion Center has included over 800 cruise engine development and component substantiation efforts spanning the engine specification qualification requirements. This paper provides a detailed account of environmental test techniques used to qualify the F107 family of gas turbine engines which propel the U.S. Cruise Missile. In addition, a missile freestream flight test simulation for the TOMAHAWK Cruise Missile is discussed along with current and future program efforts. Author

N93-17620# Microturbo, Toulouse (France).
SIMPLE AND POWERFUL TURBOJET WITH FOUR STAGE AXIAL COMPRESSOR AND AXIAL FLOW TURBINE FOR THE PROPULSION OF SUBSONIC MISSILES [TURBOREACTEUR SIMPLE ET PERFORMANT A COMPRESSOR AXIAL QUADRI-ETAGE ET TURBINE AXIALE POUR LA PROPULSION DE MISSILES SUBSONIQUES] **c07**
Jean-Paul Lopez and Charles Mischel *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 20 p In FRENCH (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

The design and development of turbojet engines for missile and target drone propulsion is a field in which MICROTURBO enjoys considerable success. A MICROTURBO engine was selected and is in current development for the APACHE standoff missile. This new single-flow, single-spool turbojet produces 550 daN at Mach 0.8; this gives an SFC figure of 1.10 kg/daN/h at 550 daN and SL Static, which drops to the region of 1 kg/daN/h at 300-400 daN. All this is accomplished by an engine that has a diameter of 343 mm. This preview outlines the tasks carried out to obtain the optimum thermodynamic definition and mechanical design of the engine. Extensive experience in the design of three and four stage compressors of this type was gained by MICROTURBO on their TRI 60 engine family. This experience was used as a basis for the conceptual design of the subject compressor with concurrent intensive use of the 3D EULER code developed by ONERA. The turbine, pre-dimensioned using conventional design methods, was also optimized by means of the EULER code. In a relatively short time, each compressor stage was manufactured then tested separately in the RACE test cell at the CEPr facilities in France, this being closely followed by complete compressor testing, during which performance expectations were met and even exceeded. Major mechanical design requisites for this life-limited engine were minimum maintenance, guaranteed performance, and low-cost production. A feasibility study on production cost effectivity, involving close liaison between the design office and methods department, was initiated in the early stage of the program. Using data provided by external suppliers, various solutions were investigated, the final selection taking into account production cost and risk factors relative to engine and/or missile integration. The result of this investigation is the wide use of castings for rotors, stators, and casings. Maximum simplicity was achieved for engine systems by designing in features such as windmill start capability, a virtually direct drive transmission to the fuel pump and the alternator, and finally, the elimination of the oil lube system. Author

N93-17621# Sundstrand Turbomach, San Diego, CA. Aerothermo Conceptual Design.
SMALLER EXPENDABLE TURBOJETS **c07**
C. Rodgers *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 12 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

One current focus of propulsion research is to increase gas turbine power density through improved aerothermodynamic component technologies and lower density, higher temperature materials. The objective of increased power density is to decrease engine size for a given output power. For example, increasing power density 100 percent, which is being projected by the 21st century, would be accompanied by a 40 percent reduction in engine size and 40 percent increase in engine speed. The trend towards reduced engine size tasks the ability of the turbojet designer to maintain the high levels of component efficiencies needed and to achieve the projected power density goals. Furthermore, parallel technology improvements projected in propulsion vehicle, system, and electronics technologies, further anticipate engine size reduction. Smaller, smarter airbreathing tactical missiles are being proposed and developed. They will function for various operational duties currently performed by larger, limited range missiles or manned surveillance and interdiction aircraft. The extreme compactness of these advanced missiles requires relatively high power density small turbojets. Several design configuration options are possible for these turbojets including centrifugal and axial turbomachinery compressor and turbines, straight annular and reverse flow annular combustors, and fuel injectors, etc. The attributes of candidate configurations are discussed with respect to maximum thrust per frontal area and low manufacturing cost. Author

N93-17622# Centre d'Etudes et de Recherches, Toulouse (France).
PREDICTION OF THE PERFORMANCES IN COMBUSTION OF RAMJETS AND STATO-ROCKETS BY ISOTHERMAL EXPERIMENTS AND MODELING [PREDICTION DES PERFORMANCES EN COMBUSTION DE STATO-REACTEURS ET STATO-FUSEES PAR EXPERIMENTATIONS ISOTHERMES ET MODELISATIONS] **c07**
P. Hebrard, G. Lavergne, A. Torgue, F. Bismes, and G. Heid *In* AGARD, Airbreathing Propulsion for Missiles and Projectiles Sep. 1992 9 p In FRENCH (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A02/MF A03

This publication presents a semi-empirical approach aimed at studying the internal aerodynamic characteristics of combustion chambers and using this information to predict the performance of various ramjet and strato-rocket combustion chambers. The step suggested, which appeared to be completely operational for numerous treated cases, is based on the joint use of experiments, carried out in isothermal simulated conditions, and of a one dimensional modeling using the concept of elementary jet engines. The experiments are undertaken on hydraulic test rigs or aerodynamic installations using reduced scale models. Conventional techniques of visualization then make it possible to reach the first qualitative description of the flow. Those are supplemented by a certain number of measurements resulting from image processing carried out on preceding visualizations. This quantitative information consisting of the distribution of flow, residence time, and concentration, is then translated into the form of input data for computer code. This calculation, carried out the second time, can use complex chemical kinetics to describe combustion and thus makes it possible to predict, with a good degree of accuracy, the total performance of the chamber (stability limits, combustion output as a function of operating characteristics, etc.,). The interest of such a step during the preliminary draft stage was shown for a significant number of chambers by comparing the results obtained in combustion with those resulting from calculation.
Transl. by FLS

N93-17743# Societe Europeenne de Propulsion, Vernon (France).
USE OF REAL FLUID THREE DIMENSIONAL FLOW COMPUTATION CODES FOR THE DESIGN OF ROCKET ENGINE ADVANCED TURBINE PUMPS [UTILISATION DE CODES DE CALCUL D'ECOULEMENTS TRIDIMENSIONNELS DE FLUIDE REEL POUR LA CONCEPTION DES TURBOPOMPES AVANCEES DE MOTEUR FUSEE]
P. Geai and J. Desclaux 1991 8 p In FRENCH Presented at 10th Congres de Mecanique, Paris, France, 2-6 Sep. 1991
(DS-2139; ETN-93-93382) Avail: NTIS HC A02/MF A01

The characteristic parameters of a space propulsion pump are discussed: the fluid flow in the pump is three dimensional, turbulent, cavitational and unsteady. The development of such a pump is traced considering the design tools used and the advantages of simulation. The development of a three dimensional real fluid code to resolve average Navier-Stokes equations is described and its objective uses are outlined. ESA

N93-17767# Naval Postgraduate School, Monterey, CA.
EMISSIVITY OF ROCKET PLUME PARTICULATES M.S. Thesis
Curtis D. Whisman Sep. 1992 44 p
(AD-A257623) Avail: CASI HC A03/MF A01

The optical properties of motor aluminum oxide are required inputs to current plume signature prediction codes, such as SIRRM. Accurate predictions are possible only if variations in the particle emissivity due to changes in particle size, contamination, and changing temperature, etc. are known. This investigation demonstrated a simplified method for determination of the emissivity of Rocket motor generated alumina. Plume particulate material was collected on tungsten alloy wire during motor firings. A DC circuit was used to resistively heat the material, and the temperature was determined at various points by relating the wire resistivity to circuit current and voltage. An Agema Thermovision infrared (3.5-5 micron) camera and microscope were used to observe the material during heating, and Broadband emissivity was computed using system software. It was estimated that the emissivity could be measured with an accuracy of plus or minus 3 percent. Motor alumina was found to have significantly greater emissivity than pure alumina in the temperature range of 500-1200 K. GRA

N93-16909*# Washington Univ., Seattle.
THERMAL MANAGEMENT IN SPACE
Abraham Hertzberg *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 57-69 (For primary document see N93-16905 05-91)
Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

N93-16913*# California Univ., San Diego, La Jolla. California Space Inst.
ALUMINUM-FUELED ROCKETS FOR THE SPACE TRANSPORTATION SYSTEM
Andrew Hall Cutler *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 109-116 (For primary document see N93-16905 05-91)
Avail: CASI HC A02/MF A02; SOD HC; 4 functional color pages

N93-16916*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ELECTRIC PROPULSION
Philip W. Garrison *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 151-159 (For primary document see N93-16905 05-91)
Avail: CASI HC A02/MF A02; SOD HC; 4 functional color pages

N93-16917*# Rockwell International Corp., Canoga Park, CA.
BEAMED ENERGY PROPULSION
James M. Shoji *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 160-171 (For primary document see N93-16905 05-91)
Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

N93-17291*# State Univ. of New York, Stony Brook. Dept. of Mechanical Engineering Technology.
STME NOZZLE THERMAL ANALYSIS
Digendra K. Das *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17295*# Alabama Univ., Huntsville. College of Engineering.
HYBRID ROCKET PERFORMANCE
Robert A. Frederick, Jr. *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17297*# Auburn Univ., AL. Dept. of Aerospace Engineering.
EXPERIMENTAL INVESTIGATION OF A SIMULATED LOX INJECTOR FLOW FIELD AND OTHER NONINTRUSIVE MEASUREMENT EFFORTS
Roy J. Hartfield, Jr. *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17298*# Cincinnati Univ., OH. Dept. of Electrical and Computer Engineering.
MODELING FOR HEALTH MONITORING AND CONTROL WITH APPLICATIONS TO THE SPACE TRANSPORTATION MAIN ENGINE
Arthur J. Helmicki *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17299*# Alabama Univ., Huntsville. Dept. of Aerospace Engineering.
POST-IMPACT BEHAVIOR OF COMPOSITE SOLID ROCKET MOTOR CASES
Alton L. Highsmith *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17339*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
ANALYSIS OF FILM COOLING IN ROCKET NOZZLES
Keith A. Woodbury *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

23 CHEMISTRY AND MATERIALS (GENERAL)

N93-17412*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SUBSTITUTED 1,1,1-TRIARYL 2,2,2-TRIFLUOROETHANES AND PROCESSES FOR THEIR SYNTHESIS Patent Application
William B. Alston, inventor (to NASA) and Roy F. Gratz, inventor (to NASA) 27 Nov. 1992 23 p
(NASA-Case-LEW-14345-7; NAS 1.71:LEW-14345-7; US-Patent-Appl-SN-982350) Avail: CASI HC A03/MF A01

Synthetic procedures to tetraalkyls, tetraacids, and dianhydrides substituted 1,1,1-triaryl 2,2,2-trifluoroethanes which comprises: (1) 1,1-bis(dialkylaryl) 1-aryl-2,2,2-trifluoroethane, (2) 1,1-bis(dicarboxyaryl) 1-aryl-2,2,2-trifluoroethane, or (3) cyclic dianhydride or diamine of 1,1-bis(dialkylaryl) 1-aryl-2,2,2-trifluoroethanes. The synthesis of (1) is accomplished by the condensation reaction of an aryltrifluoromethyl ketone with a dialkylaryl compound. The synthesis of (2) is accomplished by oxidation of (1). The synthesis dianhydride of (3) is accomplished by the conversion of (2) to its corresponding cyclic dianhydride. The synthesis of the diamine is accomplished by the similar reaction of an aryltrifluoromethyl ketone with aniline or alkyl substituted or disubstituted anilines. Also, other derivatives of the above are formed by nucleophilic displacement reactions. NASA

N93-17776*# Case Western Reserve Univ., Cleveland, OH. Dept. of Mechanical and Aerospace Engineering.

TRIBOLOGICAL AND MICROSTRUCTURAL INVESTIGATION OF THE PM200 SERIES OF SELF-LUBRICATING COMPOSITES Final Report

Michael S. Bogdanski NASA Nov. 1992 73 p

(Contracts NCC3-30; DE-AI01-91CE-50306; RTOP 505-63-5A)

(NASA-CR-190772; E-7378; DOE/NASA/0030-9; NAS 1.26:190772)

Avail: CASI HC A04/MF A01

An investigation of the effects of processing compositional variations on the tribological, microstructural, and compressive strength characteristics of PM212 is described. PM212 is a self-lubricating composite, comprised of a wear resistant metal bonded chromium carbide matrix, containing the solid lubricants barium fluoride/calcium fluoride eutectic and silver. Several alternate composites were formulated which had lubricant and matrix variations. Processing variations included sintering and hot isostatic pressing (HIPping). Pinon-disk tests were used to screen the alternates for friction and wear properties. Several of the chromium carbide-based self-lubrication composites exhibited low friction and wear in sliding against a nickel-based superalloy. One specific composition contained gold in place of silver to minimize the potential reactivity of the composite with possible environmental contaminants such as sulfur. This formulation also resulted in a composite with good tribological properties. The results indicate that several of these composites have potential use as sliding bearing and seal materials in operation from 25 C to temperatures as high as 900 C. The good tribological performance by several different composites showed that the composition of PM212 can be altered without dramatically affecting performance.

Author

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

N93-15683# Aerospace Corp., El Segundo, CA. Mechanics and Materials Technology Center.

SOME OBSERVATIONS ON STRESS GRAPHITIZATION IN CARBON-CARBON COMPOSITES

Rafael J. Zaldivar and Gerald S. Rellick 15 Sep. 1992 35 p

(Contract F04701-88-C-0089)

(AD-A256819; TR-0091(6935-06)-4; SSD-TR-92-23) Avail: CASI HC A03/MF A01

The in situ stress graphitization behavior of hard carbons in unidirectionally aligned carbon-carbon (C/C) composites was studied for three carbon fibers (PAN based T-50, pitch based PX7, and rayon based WCA) and two carbon precursor resins (phenol formaldehyde (SC1008)), and polyaryl acetylene (PAA), a high char yielding, low shrinkage resin. Graphitization was followed by measurements of density, transverse thermal expansion, d-spacing by x ray diffraction (XRD), and by scanning electron microscopy (SEM). In conjunction with xenon-ion etching, the SEM technique was found to be particularly effective in identifying localized regions of graphitized matrix. Results reveal that the graphitization of the composite is significantly greater than graphitization of fiber or matrix alone to the same temperatures. SEM observations indicate that graphitization is confined to the matrix, usually as a sheathlike structure adjacent to the fiber and 1 to 3 microns thick. Such localized graphitization, usually termed stress graphitization, is believed to be the result of thermally induced tensile or compressive stresses acting at the fiber-matrix interface. Debonded regions, which are believed to either initiate at heatup or grow from preexisting cracks in the resin-matrix composite, show less stress graphitization than well-bonded regions, presumably because the debond gaps impede stress buildup at the fiber-matrix interface. GRA

N93-15705# Aerospace Corp., El Segundo, CA. Mechanics and Materials Technology Center.

CARBORANE-CATALYZED GRAPHITIZATION IN POLYARYLACETYLENE-DERIVED CARBON-CARBON COMPOSITES

Rafael J. Zaldivar, Ross W. Kobayashi, Gerald S. Rellick, and J.-M. Yang 15 Sep. 1992 35 p

(Contract F04701-88-C-0089)

(AD-A256826; TR-0090(5935-06)-2; SSD-TR-92-22) Avail: CASI HC A03/MF A01

Boron in the form of a carborane compound, C2B10H12, was used to catalytically graphitize a polyarylacetylene (PAA) resin, typically a nongraphitizing carbon, in bulk form and in a carbon-carbon (C/C) composite. In bulk form, significant graphitization was observed after heat treatment to 1800 C; complete graphitization was realized at 2400 C. Similar results were found for a PAA derived carbon matrix in a unidirectional C/C composite. The effect of carborane addition on the mechanical properties of C/C unidirectional composites of PAA and T-50 carbon fibers was also examined. After heat treatment to 1100 C, the tensile strength of unidirectional fiber tows increased significantly with increasing concentration of carborane. The increase in tensile strength was accompanied by increased fiber pullout, suggesting that interface weakening decreases the tendency for matrix-dominated brittle fracture. After heat treatment to 1800 C and above, the carborane decreased the strength of the composites but substantially increased the modulus. Catalytic graphitization of PAA offers a major potential advantage of obtaining graphitic matrices in C/C without the disadvantages of conventional pitch processing. In addition, the much lower temperatures required for catalytic graphitization would enable processing temperatures for C/C to be reduced significantly. GRA

N93-15706# Army Lab. Command, Watertown, MA. Material Technology Lab.

FLAMMABILITY CHARACTERISTICS OF FIBER-REINFORCED EPOXY COMPOSITES FOR COMBAT VEHICLE APPLICATIONS Final Report

Domenic P. Macaione Aug. 1992 22 p

(AD-A256844; MTL-TR-92-58) Avail: CASI HC A03/MF A01

The use of composites in U.S. Army systems as a means of decreasing weight and enhancing survivability, without reducing personnel safety, has been considered for some time. The U.S. Army Materials Technology Laboratory (MTL) successfully demonstrated in an earlier program that a ground vehicle turret could be fabricated from fiber-reinforced composite material. This technology was successfully extended to the fabrication of a composite vehicle hull in an earlier phase of the current program. Organic polymers are one of the major constituents of fiber-reinforced composites. As components of military systems these materials are expected to survive combustion and pyrolysis processes associated with fires. It is, therefore, necessary to develop an understanding of the flammability behavior of composite materials in the early design stages of a military vehicle such as the Composite Infantry Fighting Vehicle (CIFV), the Advanced Systems Modification (ASM), or any future U.S. Army combat vehicle. The present study attempts to characterize the flammability behavior of composite materials associated with Phase 3 of the CIFV Hull program in terms of accepted fire resistant material evaluation parameters. GRA

N93-15997# Aerospace Corp., El Segundo, CA. Technology Operations.

SURFACE ANALYSES OF COMPOSITES EXPOSED TO THE SPACE ENVIRONMENT ON LDEF

J. J. Mallon, J. C. Uht, and C. S. Hemminger 31 Aug. 1992 36 p

(Contract F04701-88-C-0089)

(AD-A257141; TR-92(2935)-3; SMC-TR-92-44) Avail: CASI HC A03/MF A01

We have conducted a series of surface analyses on carbon fiber/polyarylacetylene matrix composites that were exposed to the space environment on the Long Duration Exposure Facility (LDEF) satellite. These composite panels were arranged in pairs on both the leading edge and trailing edge of LDEF. None of the composites were severely damaged by nearly six years of exposure to the space environment. Composites on the leading edge exhibited 5 mils of surface erosion, but trailing edge panels exhibited no physical appearance changes due to exposure. Scanning electron microscopy (SEM) was used to show that the erosion morphology on the leading edge samples was dominated by crevasses parallel to the fibers with triangular cross sections 10 to 100 microns deep. The edges of the crevasses were well defined and penetrated through both matrix and fiber. The data suggest that the carbon fibers are playing a significant role in crevasse initiation and/or enlargement, and in the overall erosion rate of the composite. X ray photoelectron spectroscopy (XPS) and energy dispersive x ray spectroscopy (EDS) results showed the presence of silicone and hydrocarbon contamination from in-flight sources. The role of contamination in crevasse initiation and enlargement is unknown as this time. GRA

N93-16047# Army Materials Technology Lab., Watertown, MA.
CHARACTERIZATION OF THICK GLASS REINFORCED COMPOSITES Final Report
Jonathan Fazli, Elizabeth Goeke, and John Nunes Jul. 1992 23 p
(AD-A256881; MTL-TR-92-43) Avail: CASI HC A03/MF A01

As a follow-on to a composite structural armor development program, a mechanical testing program for the composite materials was carried out. The composites are thick laminates of glass fabric and polyester resin. The tests used were flexure, tension, and compression. Because of the laminate thickness, redesign of the standard test specimens was necessary. The test results provide a characterization of the materials. GRA

N93-16090# Oak Ridge National Lab., TN.
ION IMPLANTATION EFFECTS IN SILICON CARBIDE
C. J. McHargue (Tennessee Univ., Knoxville.) and J. M. Williams Aug. 1992 17 p Presented at the 8th International Conference on Ion Beam Modification of Materials, Heidelberg (Germany), 7-11 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE92-041306; CONF-9209200-2) Avail: CASI HC A03/MF A01

Results from a program, on ion implantation effects in alpha and beta silicon carbide are summarized. Silicon carbide is easily amorphized by ion implantation at room temperature. Amorphization as determined by Rutherford backscattering spectrometry (RBS) occurs for damage energies of about 20 eV/atom, corresponding to 0.2 to 0.3 displacements per atom (dpa), at room temperature. Implantation at higher temperatures (approx. 500 C or above) does not produce an amorphous region for damage levels as high as 17 dpa. Recovery of damage at the subamorphous damage level is fairly complete by 1000 C. Epitaxial regrowth after amorphization occurs over a very narrow temperature range at approx. 1500 C in an almost 'explosive' fashion. Damage and amorphization are accompanied by swelling of up to 15 percent. The hardness and elastic modulus values of amorphous SiC are 40 and 70 percent, respectively, of the unimplanted single crystalline values, but before amorphization, the hardness first increases during the early damage phase and then decreases upon amorphization. The oxidation and chemical etching rates of the amorphous state are higher than for crystalline material. Amorphization kinetics, annealing kinetics and property changes are broadly compatible with the idea of a critical accumulation model for amorphization. DOE

N93-16107# Army Lab. Command, Watertown, MA. Material Technology Lab.
AN INTRODUCTION TO MOIRE METHODS WITH APPLICATIONS IN COMPOSITE MATERIALS Final Report
Robert F. Anastasi Aug. 1992 60 p
(AD-A255686; MTL-TR-92-55) Avail: CASI HC A04/MF A01

The Moire effect or the fringe pattern formed by superimposing two arrays of dark and light line patterns is utilized in experimental mechanics to measure deformations of bodies subjected to external loads. Although mainly a laboratory tool, the techniques have been applied to problems in the mechanics of composite materials to map strain concentrations around holes, cracks, and delamination, as well as examining edge effects, shearing deformation, and mechanically fastened composite material. GRA

N93-16252# Maryland Univ., College Park. Metallurgical Materials Lab.
STRENGTHENING OF NiAl MATRIX COMPOSITES Annual Report, Oct. 1991 - Sep. 1992
Richard J. Arsenault Oct. 1992 58 p
(Contract N00014-91-J-1353)
(AD-A256970) Avail: CASI HC A04/MF A01

An investigation was undertaken to determine if by cryomilling NiAl and TiB2 powders, ultra fine subgrain or grain size material could be obtained. If this ultra fine grain size composite were produced then it was assumed there should be a significant increase in the strength. Cryomilling did decrease the grain or subgrain size but the strength of the 20 V pct. TiB2/NiAl composite was the same as 20 V pct. TiB2 made by the XDTM process. Also, a 0 V pct. TiB2/NiAl composite produced from cryomilled NiAl was about the same strength as the 20 V pct. TiB2/NiAl composites. The above mentioned composites were made by HIPPing and extrusion. If the 0 V pct. TiB2/NiAl cryomilled composite is tested in the as HIPPed condition, the strength is much greater. A TEM investigation has shown that in case of extruded cryomilled composites there is a dispersion of small 10 to 20 nm Al2O3 and AlN particles. In the case of the as HIPPed cryomilled composite the Al2O3 and AlN formed a network at the grain boundaries. GRA

N93-16255# IAP Research, Inc., Dayton, OH.
A LASER SPECTROSCOPY TECHNIQUE FOR EVALUATING IN-SITU DEGRADATION OF COMPOSITE MATERIALS
Duane C. Newman and Bhanumathi Chelluri 18 Sep. 1992 27 p
(Contract DAAL03-92-C-0008)
(AD-A256983; IAP-TR-92-06; ARO-29471.1-MS-SBI) Avail: CASI HC A03/MF A01

Advanced materials are being implemented in many Army systems. These systems require new nondestructive techniques for assessing in service degradation. Secondly, techniques are required to assess material integrity during manufacturing. A NDE technique is proposed based on Brillouin Scattering that is capable of determining changes in elastic constants of polymer based composite materials and composite materials. The change in elastic constants can then be used to predict component mechanical property degradation caused by thermal or low velocity compact damage. In the case of processing feedback the technique will allow for the in-situ evaluation of the effect of processing variables on mechanical properties. GRA

N93-16281# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
LAMINATED CONICAL SHELLS: CONSIDERATIONS FOR THE VARIATIONS OF THE STIFFNESS COEFFICIENTS
Menahem Baruch (Technion - Israel Inst. of Engineering, Haifa.), Johann Arbocz (Technion - Israel Inst. of Engineering, Haifa.), and Guo-Qi Zhang Apr. 1992 70 p
(LR-671; ETN-92-92868) Avail: CASI HC A04/MF A01

The stiffness coefficients of a laminated conical shell, orthotropic or in some more general mode, are usuallly assumed to be constant. It is shown that due to the geometry of the conical surface, in connection with the filament winding process necessary to build the laminated conical shell, this can never be achieved. To calculate the varying stiffness coefficients of a laminated conical shell, the geometry of the shell and the winding process needed to build the shell must be taken into account. A method to calculate those stiffness coefficients is proposed. Stiffeners can be used on laminated or isotropic conical shells. A method to calculate the varying stiffness coefficients due to the stiffeners is proposed. The geodesic paths, which are the practical ways to position the fibers, are examined. Of course the stiffeners can also be placed on these paths. However, other paths are also examined. Stiffeners, for example, can be placed on these paths for optimization purposes. The stiffness coefficients of a laminated conical shell always vary and are functions of the coordinates of the shell. It is shown that by proper filament winding process these functions can be made to be functions of the longitudinal coordinate only. ESA

N93-16403# Aeronautical Research Labs., Melbourne (Australia).
DEVELOPMENT OF A MENU DRIVEN MATERIALS DATA BASE FOR USE ON PERSONAL COMPUTERS: AIRCRAFT STRUCTURES TECHNICAL MEMORANDUM
R. H. Kaye Jul. 1992 36 p
(AD-A256317; ARL-STRUC-TM-584; DODA-AR-007-074) Avail: CASI HC A03/MF A01

This Memorandum presents a PC based, menu driven materials data base for the engineering related properties of advanced structural materials. General materials information and suppliers' details are also provided. Data retrieval is performed by a TURBO PASCAL program of less than 100 lines, accessing several separate text files. This program will run under most MSDOS installations. Response time and accessing time is negligible on any IBM XT (or faster) machine and a graphics adaptor is not required. GRA

N93-16476# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Abteilung Betriebsnahe Ermuedungsfestigkeit.
MECHANICAL PROPERTIES OF CARBON FIBRE REINFORCED PLASTICS (CFRP) UNDER VARIATION OF FIBRE AND MATRIX STRAIN TO FAILURE Ph.D. Thesis - Bremen Univ. [MECHANISCHE EIGENSCHAFTEN KOHLENSTOFFASERVERSTAERKTER KUNSTSTOFFE (CFK) BEI VARIATION DER MATRIXDUKTILITAET UND DER BRUCHDEHNUNG DER FASERN]
Christian Baron Feb. 1990 133 p In GERMAN Sponsored by DFG
(DLR-FB-90-06; ETN-93-92402) Avail: CASI HC A07/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 660 58, 5000 Cologne, Germany, HC

The potential benefits of carbon fibers, with higher fracture strength and strain, and ductile matrices on the mechanical properties of different laminates are described. The improvements obtained for static loadings, when using ductile matrices and fibers with an increased strain to failure was not corroborated in the same range for the fatigue life. The variation of the electrical resistivity of the loaded carbon fibers was continuously measured and correlated to fiber fracture. ESA

N93-16537*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RELATIONSHIP BETWEEN MECHANICAL-PROPERTY AND ENERGY-ABSORPTION TRENDS FOR COMPOSITE TUBES
Gary L. Farley (Army Vehicle Structures Lab., Hampton, VA.) Dec. 1992 16 p
(DA Proj. 1L1-61102-AH-45; RTOP 505-63-50-08)
(NASA-TP-3284; L-17087; NAS 1.60:3284; ARL-TR-29) Avail: CASI HC A03/MF A01

U.S. Army helicopters are designed to dissipate prescribed levels of crash impact kinetic energy without compromising the integrity of the fuselage. Because of the complexity of the energy-absorption process it is imperative for designers of energy-absorbing structures to develop an in-depth understanding of how and why composite structures absorb energy. A description of the crushing modes and mechanisms of energy absorption for composite tubes and beams is presented. Three primary crushing modes of composite structures including transverse shearing, lamina bending, and local buckling are described. The experimental data presented show that fiber and matrix mechanical properties and laminate stiffness and strength mechanical properties cannot reliably predict the energy-absorption response of composite tubes. Author

N93-16591# Army Materials Technology Lab., Watertown, MA.
RECENT DEVELOPMENTS OF CARBON FIBER IN JAPAN
Sin-Shong Lin Jul. 1992 18 p Previously announced in IAA as A92-47498 Submitted for publication
(MTL-TR-92-48) Avail: CASI HC A03/MF A01

This article surveys current progress and strides made in the development of carbon fiber by Japanese governmental and industrial laboratories during the past three years. The progress is clearly visible from large numbers of publications, patent applications, and fiber products. The carbon fiber production, processing advancements, fiber developments, and future prospects are described briefly in terms of new processing knowledge and novel fiber characteristics. Author

N93-16855# Tel-Aviv Univ. (Israel). Dept. of Mechanical Engineering.
THE PREDICTION OF THE OVERALL BEHAVIOR OF VISCOUS COMPOSITES M.S. Thesis
Sarit Goldstein May 1990 179 p In HEBREW
(ITN-93-85184) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

An investigation of the overall behavior of a power law viscous composite is carried out. For the prediction of the overall behavior of the composite, a first order continuum theory is used with microstructure. The composite is modeled by a triply periodic array of cubic inclusions which are embedded in a matrix in the form of a cubic array. The average response of the composite to a given type of loading is determined from the known mechanical properties of the phases and their relative volumes, in conjunction with continuity tractions and velocities across the cubic subcell interfaces on the average basis. Particulate composites, including porous materials and rigid and elastic inclusions in a viscous matrix are obtained by a proper selection of mechanical properties. The predicted behavior obtained was compared with that obtained by other approaches and satisfactory agreement was obtained. Author (ISA)

N93-16856 Tel-Aviv Univ. (Israel). Dept. of Solid Mechanics, Materials and Structures.
THE THERMOVISCOELASTIC BEHAVIOR OF COMPOSITE MATERIALS M.S. Thesis
Yosef Sadkin Apr. 1990 173 p In HEBREW
(ITN-93-85185) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

A method of analysis, based on a micromechanical theory, is presented for the prediction of the mechanical performance of viscoelastic unidirectional fiber-reinforced composites, under conditions of mechanical and temperature variation with time. The theory postulates a geometric modular array of periodically distributed rectangular cells. A representative volume element consists of a typical set of subcells made out of fibers or matrix material. By considering continuity conditions of tractions and displacements at the boundary interfaces of the constituent subcells, in conjunction with their corresponding individual fiber or matrix constitutive equations, as applicable, a small set of linear algebraic equations are derived. As a result, from the known mechanical properties of the fiber/matrix constituents and respective volumetric ratios it is possible, by application of the proposed theory, to determine the mechanical behavior of various types of viscoelastic composites. As an extension of the above method of analysis, it is also possible to consider a composite material in which the matrix is modeled as a thermorheologically complex solid. In this case, the overall thermoviscoelastic behavior of the composite exhibits a thermorheologically complex behavior as well. It should be noted that a thermorheologically complex material polymer can be fully characterized at any temperature by introducing horizontal and vertical logarithmic shifts to its mechanical properties at a reference temperature. An analytical representation of the polymer properties are obtained based on principles of continuum mechanics, thermodynamic theory, and experimental results. Author (ISA)

N93-16926# Northwestern Univ., Evanston, IL. Dept. of Physics and Astronomy.
ENERGETICS, BONDING MECHANISM AND ELECTRONIC STRUCTURE OF METAL/CERAMIC INTERFACES
A. J. Freeman 1993 8 p
(Contract DE-FG02-88ER-45372)
(DE93-003121; DOE/ER-45372/5) Avail: CASI HC A02/MF A01

Progress are reported on: electronic structure of PdO, PtO, and AgO (band structure calculations); ab initio calculations of electronic structure of TiO2(110) surface; and electronic structure of VO2 and TiO2 thin films and multilayers. DOE

N93-17004# Argonne National Lab., IL.
MICROSTRUCTURE/MECHANICAL-PROPERTY RELATIONSHIPS AND R-CURVE BEHAVIOR IN Si3N4/Si3N4(w) COMPOSITES
J. P. Singh, C. Y. Chu, C. Murphy, and D. Singh Jun. 1992 17 p Presented at the 24th International Society for the Advancement of Material and Process Engineering Technical Conference, Toronto, Ontario, 20-22 Oct. 1992
(Contract W-31-109-eng-38)
(DE92-041096; ANL/CP-76346; CONF-9210175-1) Avail: CASI HC A03/MF A01

Fracture toughness of Si3N4-whisker-reinforced Si3N4-matrix composites were evaluated with various whisker contents. Toughness was observed to increase with increasing whisker content, reaching a maximum value of 8.8 MPa(sq. root of m) at 5 vol. percent whisker content. Additional whisker content caused reduced toughness. A model based on microstructural features indicates that the observed dependence of toughness on whisker content is due to both whisker-toughening and matrix-grain-size effects. Composites with 5 vol. percent whisker content showed a rising crack growth resistance (R-curve) behavior. This is believed to be a combined effect of crack bridging and crack deflection due to both elongated grains and reinforcing whiskers. DOE

N93-17030# Lawrence Livermore National Lab., CA.
MATRIX-DOMINATED MECHANICAL PROPERTIES OF A FIBER COMPOSITE LAMINA

R. E. Lyon, D. L. Schumann, and S. J. DeTeresa 18 May 1992 24 p Presented at the 11th American Society for Testing and Materials Symposium on Composite Materials: Testing and Design, Pittsburgh, PA, 4-5 May 1992
(Contract W-7405-eng-48)
(DE93-001320; UCRL-JC-110665; CONF-9205232-1) Avail: CASI HC A03/MF A01

Matrix-dominated mechanical properties of unidirectional fiber composite laminae were determined from hoop-wound tube specimens and cylindrical rods fabricated from both wet-filament winding and prepreg material systems. Longitudinal shear modulus and strength as well as transverse Young's modulus, transverse tensile strength, and transverse compressive strength were obtained from a thin-walled tube specimen using a new fixturing design. Lamina properties are presented for several carbon fiber/epoxy composite materials. Longitudinal shear moduli were measured for both tubes and rods in torsion. Results obtained in the linear-elastic regimes above and below the glass transition temperature (Tg) of the matrix phase were compared with micromechanics predictions. Although agreement between predicted and measured shear moduli was reasonable below Tg, large discrepancies were observed when the matrix phase was elastomeric. DOE

N93-17082# Pennsylvania State Univ., University Park. Materials Research Lab.
MULTIFUNCTIONAL NANOCOMPOSITE MATERIALS
R. Roy and S. Komarneni Nov. 1991 9 p
(Contract DE-FG02-85ER-45204)
(DE93-002767; DOE/ER-45204/T5) Avail: CASI HC A02/MF A01

The objective is to examine the low temperature nanocomposite route in the synthesis of multifunctional materials using two-dimensional clays as hosts. After about 8 months, a significant advance was made in the design and synthesis of novel nanocomposite materials, which are nanometal intercalated clays prepared by a low temperature route. A layered V2O5 gel has been made hydrothermally and its cation exchange properties measured. Several pillared clays have also been synthesized and characterized. DOE

N93-17541# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
A LITERATURE SURVEY ON THE FATIGUE BEHAVIOUR OF HYBRID COMPOSITES
A. Oldersma 2 Sep. 1991 29 p Sponsored by Nederlandse Maatschappij voor Energie en Milieu
(NLR-TP-91345-U; ETN-92-92523) Avail: CASI HC A03/MF A01

Fatigue behavior of composite materials is discussed and the behavior of hybrid composites, composite materials with more than one type of fiber in one matrix, is related to simple (single fiber) composites. The properties and the behavior of hybrid composites can mostly be explained qualitatively, considering the strain in the laminate. The fatigue behaviors of hybrid composites show an upward deviation from the behavior predicted by the properties of the 'single fiber' composites and the relative volume fractions of the types of fiber present. ESA

N93-17582# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
MANUFACTURING AND INSPECTION OF ARTIFICIAL DELAMINATIONS IN COMPOSITE MATERIALS
J. H. Heida, G. Beuker, and M. Verdegaal 26 Feb. 1991 9 p Presented at 5th European Conference on Non-Destructive Testing, Sarajevo, Yugoslavia, 22-27 Sep. 1991
(NLR-TP-91085-U; ETN-92-92515) Avail: CASI HC A02/MF A01

A new method for the manufacturing of artificial delaminations in carbon fiber reinforced plastic is presented, making use of thin metal foils. The method results in artifical delaminations with total thickness less than 15 or 30 microns, depending on the type of application. The artificial delaminations are real delaminations in the sense of local separation of the laminate plies, with an air gap. They show a similar reflection and transmission behavior for ultrasonic signals, compared with real delaminations. The artificial delaminations can therefore be properly used for inspection calibration purposes. ESA

N93-17603# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
RADIATION EFFECTS AND MICROMECHANICS OF SiC/SiC COMPOSITES
N. M. Ghoniem 1992 5 p
(Contract DE-FG03-91ER-54115)
(DE93-003268; DOE/ER-54115/T2) Avail: CASI HC A01/MF A01

The basic displacement damage process in SiC has been fully explored, and the mechanisms identified. Major modifications have been made to the theory of damage dosimetry in fusion, fission, and ion simulation studies of SiC. For the first time, calculations of displacements per atoms in SiC can be made in any irradiation environment. Applications to irradiations in fusion first wall neutron spectra (ARIES and PROMETHEUS) as well as in fission spectra (HIFIR and FFTF) are given. Nucleation of helium-filled cavities in SiC was studied, using concepts of stability theory to determine the size of the critical nucleus under continuous generation of helium and displacement damage. It is predicted that a bimodal distribution of cavity sizes is likely to occur in heavily irradiated SiC. A study of the chemical compatibility of SiC composite structures with fusion reactor coolants at high-temperatures was undertaken. It was shown that SiC itself is chemically very stable in helium coolants in the temperature range 500-1000 C. However, current fiber/matrix interfaces, such as C and BN are not. The fracture mechanics of high-temperature matrix cracks with bridging fibers is now in progress. A fundamentally unique approach to study the propagation and interaction of cracks in a composite was initiated. The main focus of our research during the following period will be: (1) theory and experiments for the micro-mechanics of high-temperature failure; and (2) analysis of radiation damage and microstructure evolution. DOE

N93-17692# Naval Postgraduate School, Monterey, CA.
COMPUTER SIMULATION OF RANDOM AND NON-RANDOM SECOND-PHASE PARTICLE DISTRIBUTIONS FOR BOTH CONSTANT AND VARYING PARTICLE SIZE M.S. Thesis
Mark S. Manfredi Sep. 1992 116 p
(AD-A257700) Avail: CASI HC A06/MF A02

Mechanical properties of two phase materials, such as strength, ductility, and toughness, depend on the size and distribution of the second phase. However, no methods are presently available to accurately quantify the homogeneity of the distribution of the second phase. Here, random and nonrandom second-phase particle distributions have been simulated by computer and analyzed for various area fractions. Distributions of particles with a lognormal size distribution have been analyzed as well. A statistically sufficient number of particles for use in the model was determined and used for all simulations. Average first nearest neighbor spacing values for dilute arrays of particles approach those of Poisson distributions of infinitesimal points. As the particle density increases, the average spacing values approach those of hexagonal arrays. For low area fractions, there is little distinction between random and nonrandom distributions, both from statistical and visual perspectives. For higher area fractions, there is a discernable difference between the statistical data for random and nonrandom distributions, but the visual differences are more obvious. These observations hold for both constant size particles and particles with a lognormal size distribution. GRA

N93-17747# Societe Europeenne de Propulsion, Vernon (France). Div. Propulsion a Poudre et Composites.
SEP HIGH PERFORMANCE COMPOSITE MATERIALS: MORE THAN A JOB... A VOCATION [LES MATERIAUX COMPOSITES HAUTES PERFORMANCES A LA SEP: PLUS QU'UN METIER... UNE VOCATION]
Jean-Jacques Choury 1991 10 p Repr. from Revue UE ENSAM 91, 1991 p 101-110 In FRENCH
(DS-2134; ETN-93-93388) Avail: CASI HC A02/MF A01

Activities of SEP (French acronym for European propulsion company) involving composite materials are addressed. The development of different composite materials is described together with their applications: stiff ablative composites with a phenolic resin base; rubber composites used for internal thermal protection of engines; elastomer laminates used in engine nozzles; carbon-carbon used in powder engine nozzles brake disks and for artificial limbs; and ceramic matrix composites used in aircraft engines, liquid propulsion rocket engines and aeronautical spatial constructions. Composite structures and thermal composite structures are also addressed. ESA

N93-15725# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Strukturmechanik.
CRACK INITIATION AND GROWTH IN NOTCHED CFRE LAMINATES: FEM ANALYSES AND TESTS
Michael Gaedke *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 987-992 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15741# Centre National d'Etudes Spatiales, Toulouse (France).
DAMAGE MECHANICS MODELISATION OF COMPOSITE STRUCTURES: A PHYSICAL APPROACH OF FAILURE
L. Perret, E. LeDantec (Bertin et Cie., Plaisir, France), and D. Engrand (Bertin et Cie., Plaisir, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 659-664 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15742# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Strukturmechanik.
DAMAGE MECHANISMS AND CONSTITUTIVE RELATIONS FOR CRACKED UD-LAYERS IN CROSSPLY LAMINATES
H. Eggers and H. C. Goetting *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 665-669 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-15743# Engineering System International, Rungis (France).
COMPOSITE MATERIAL DAMAGE AND FRACTURE MODELS FOR NUMERICAL SIMULATIONS IN SUPPORT OF FRACTURE CONTROL
A. deRouvray, E. Haug, and C. Stavrinidis *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 671-678 Sponsored in part by ESA/ESTEC (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15759# Dornier System G.m.b.H., Friedrichshafen (Germany).
A HIGH PRECISION SANDWICH REFLECTOR FOR FIRST: DESIGN AND MECHANICAL ANALYSIS OF THE SANDWICH CORE
Rudolf Sippel and Gunter Helwig *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 783-787 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-16780*# Massachusetts Inst. of Tech., Cambridge.
PREDICTION OF THERMAL CYCLING INDUCED MATRIX CRACKING
Hugh L. McManus *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 143-146 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17340*# Tuskegee Inst., AL. Dept. of Aerospace Science Engineering.
STRESS ANALYSIS AND DAMAGE EVALUATION OF FLAWED COMPOSITE LAMINATES BY HYBRID-NUMERICAL METHODS
Yii-Ching Yang *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N93-15676# California Univ., Berkeley. Lawrence Berkeley Lab.
SPECTROSCOPIC AND MAGNETIC STUDIES OF TETRAVALENT Pa AND TRIVALENT Th COMPOUNDS
N. M. Edelstein and W. K. Kot Jun. 1992 22 p Presented at the Conference on Rare Earths, Kyoto (Japan), 1-5 Jun. 1992
(Contract DE-AC03-76SF-00098)
(DE92-041214; LBL-32473; CONF-920625-6) Avail: CASI HC A03/MF A01

At the beginning of the actinide series, the 5f and 6d configurations are very close in energy. Consequently, both the 5f and 6d energy level splittings may be observed experimentally in Pa(sup 4+) and Th(sup 3+) compounds. The available magnetic and optical data on these systems are reviewed. DOE

N93-15677# California Univ., Berkeley. Lawrence Berkeley Lab.
THE ELECTRICAL CONDUCTIVITY OF SODIUM POLYSULFIDE MELTS Ph.D. Thesis
Mei-Hui Wang Jun. 1992 95 p
(Contract DE-AC03-76SF-00098)
(DE92-041217; LBL-32538) Avail: CASI HC A05/MF A01

The sodium polysulfide melt has been described by a macroscopic model. This model considers the melt to be composed of sodium cations, monosulfide anions, and neutral sulfur solvent. The transport equations of concentrated-solution theory are used to derive the governing equations for this binaryelectrolyte melt model. These equations relate measurable transport properties to fundamental transport parameters. The focus of this research is to measure the electrical conductivity of sodium polysulfide melts and calculate one of fundamental transport parameters from the experimental data. The conductance cells used in the conductivity measurements are axisymmetric cylindrical cells with a microelectrode. The electrode effects, including double-layer capacity, charge transfer resistance, and concentration overpotential, were minimized by the use of the alternating current at an adequately high frequency. The high cell constants of the conductance cells not only enhanced the experimental accuracy but also made the electrode effects negligible. The electrical conductivities of sodium polysulfide Na2S4 and Na2S5 were measured as a function of temperature (range: 300 to 360 C). Variations between experiments were only up to 2 percent. The values of the Arrhenius activation energy derived from the experimental data are about 33 kJ/mol. The fundamental transport parameter which quantifies the interaction within sodium cations and monosulfide anions are of interest and expected to be positive. Values of it were calculated from the experimental conductivity data and most of them are positive. Some negative values were obtained probably due to the experimental errors of transference number, diffusion coefficient, density or conductivity data. DOE

N93-15694# Texas Univ., Austin. Dept. of Chemistry.
MORPHOLOGICAL ASPECTS OF SURFACE REACTIONS
J. M. White Aug. 1992 23 p
(Contract DE-FG05-86ER-13626)
(DE92-040522; DOE/ER-13626/6) Avail: CASI HC A03/MF A01

This program involves the preparation and characterization (both structural and kinetic) of metal-based catalysts and adsorbates thereon. The substrates involve mainly Rh and Ag; oxides of Si, Al and Ti are used for supports for particles and thin metal films. Adsorbates include carbon oxides, halogenated hydrocarbons, benzene and alkalis. Particular attention is given to synthesis of hydrocarbon fragments by photochemical and electron-induced methods. Tunneling microscopy and spectroscopy are used to study the morphology and electronic structure of the metals. DOE

N93-15840# Minnesota Univ., Minneapolis.
HOMOGENEOUS-HETEROGENEOUS COMBUSTION: THERMAL AND CHEMICAL COUPLING
Jan. 1992 6 p
(Contract DE-FG02-88ER-13878)
(DE93-002881; DOE/ER-13878/4) Avail: CASI HC A02/MF A01

This is a program to characterize fundamental issues and practical applications of homogeneous-heterogeneous reactions. Fundamental studies of reactions at low pressures and of boundary layer characterization give microscopic information on the processes. Ignition and extinction studies over simple geometries give basic bifurcation behavior with which to characterize multiple steady states and their stabilities and hopefully to identify the types of behavior which may occur. Use of catalytic monoliths will permit examination of the chemical and thermal performance of one of the most important types of geometries in which both types of reaction can occur. Modeling will tie all of these aspects together by showing how

individual components interact, predicting performance of monoliths, and providing the framework for translating these ideas into technological contexts. DOE

N93-15842# Army Cold Regions Research and Engineering Lab., Hanover, NH.

SUPERCRITICAL FLUID CHROMATOGRAPHY FOR THE ANALYSIS OF NITROAROMATICS, NITRAMINES, AND NITRATE ESTERS Special Report

Paul H. Miyares Aug. 1992 18 p

(AD-A256297; CRREL-SR-92-21) Avail: CASI HC A03/MF A01

A supercritical fluid chromatographic (SFC) system equipped with a capillary column and a thermionic ionization detector (TID) was evaluated as a potential analytical tool for the simultaneous determination of nitroaromatics, nitramines and nitrate esters. Examination of several stationary phases and modified fluids was carried out while determining optimal conditions for a suitable separation. The results indicate that a cyanopropyl stationary phase is best suited for these analytes, but the available percentages of cyanopropyl in the phase (i.e., 25 and 50 percent) do not give total resolution. The performance and usability of the TID was evaluated. Detection limits are estimated to be several times greater than those for standard HPLC and GC methods. Also, the usability and performance of the SFC were compared with HPLC and GC. SFC-TID can be used for the simultaneous determination of nitroaromatic, nitramines and nitrate esters, but current column and detection capability limitations greatly reduce its potential. GRA

N93-15913# Purdue Univ., West Lafayette, IN. Dept. of Chemistry.

PROBING ELECTROCHEMICAL ADSORBATE STRUCTURE AND REACTIONS WITH IN-SITU ATOMIC-RESOLUTION SCANNING MICROSCOPY: SOME PROGRESS AND PROSPECTS

Xiaoping Gao and Michael J. Weaver Oct. 1992 38 p

(Contract N00014-91-J-1409)

(AD-A256660; TR-135) Avail: CASI HC A03/MF A01

Some prospects for applying scanning tunneling microscopy (STM) as an in-situ atomic-resolution probe of adlayer structure at ordered metal-solution interfaces are considered with respect to both equilibrium and reactive adsorbate systems. Illustrative results of the former type are presented for the potential-dependent adsorption of iodide at low-index gold electrodes. The virtues of acquiring composite-domain STM images, where the electrode potential is altered during data acquisition so to form or remove the adsorbed adlayer, are noted. By generating temporally and spatially adjacent domains featuring substrate and adlayer images in this fashion, the registry between the former and latter atomic arrangements can be deduced with high precision. The suitability of in-situ STM for examining real-space dynamics of surface physical and chemical processes is illustrated for potential-induced reconstruction of Au(100) and for the electrooxidative polymerization of iodide and sulfide. Some limitations as well as strengths of in-situ STM for these purposes are briefly outlined with regard to its anticipated role in the development of in-situ electrochemical surface science. GRA

N93-15925# Argonne National Lab., IL.

RECYCLING HYDROGEN AND SULFUR BY MICROWAVE CHEMICAL PROCESSING

J. B. L. Harkness and R. D. Doctor 1992 7 p Presented at the Conference for Southern States on Waste Minimization, Pollution Prevention and Environmental Regulations, Biloxi, MS, 22-24 Sep. 1992

(Contract W-31-109-eng-38)

(DE92-040744; ANL/CP-76897; CONF-9209186-2) Avail: CASI HC A02/MF A01

A waste treatment process is being developed that recovers both hydrogen and sulfur from hydrogen sulfide contaminated industry waste. The proposed process uses microwave energy to initiate plasma-chemical reactions that dissociate hydrogen sulfide into elemental hydrogen and sulfur. Using a reaction scheme that recovers a hydrogen product has several advantages over the current Claus technology that burns the hydrogen to water. Both processes produce a clean sulfur product that can be recovered and sold. However, the microwave process produces a gaseous stream that is purified and then separated into streams containing the product hydrogen, hydrogen sulfide for recycle to the plasma-chemical reactor, and the process purge containing carbon dioxide and water. Experiments with pure hydrogen sulfide at flow rates of 0.5 to 1.5 L/min and microwave powers of 400 to 1,000 W had previously confirmed that conversions of over 90 pct. per pass are possible. Experiments with impurities typical of petroleum refinery waste hydrogen sulfide streams have demonstrated that these impurities are compatible with the plasma dissociation process and that they do not appear to create new waste treatment problems. Later experiments showed that the cyclonic-flow pattern hypothesized by the Russian theoretical analysis of the plasma-chemical process can substantially decrease hydrogen sulfide dissociation energy requirements while increasing conversion. This technology has a long term potential for saving five hundred million to one billion dollars annually in the refining industry. DOE

N93-15931# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

CHEMICAL KINETIC AND AERODYNAMIC STRUCTURES OF FLAMES Final Report, 1 Mar. 1989 - 28 Feb. 1992

C. K. Law 11 Jun. 1992 77 p

(Grant AF-AFOSR-0293-89)

(AD-A256015; AFOSR-92-0894TR) Avail: CASI HC A05/MF A01

The objective of the present program was to study the aerothermochemical structure of laminar premixed and nonpremixed-flames through (1) non-intrusive experimental determination in reduced and elevated pressure environments, (2) computational simulation using detailed flame and kinetic codes, and (3) asymptotic analysis with simplified and reduced mechanisms. Useful theoretical and experimental contributions were made on the determination of the burning rates and flame kinetics of the lower hydrocarbons, on the understanding of the physical and chemical parameters influencing soot formation in diffusion flames, on the identification of the role of kinetics and system non-adiabaticity in flammability limits, and on adiabatic flame stabilization. These results are relevant to the fundamental and practical issues of flame kinetics, turbulent combustion, soot formation, radiative heat transfer, flame extinction, stabilization and flammability, and supersonic combustion. GRA

N93-15942# California Univ., Berkeley. Lawrence Berkeley Lab.

FUNDAMENTAL STUDIES OF THE MECHANISM OF CATALYTIC REACTIONS WITH CATALYSTS EFFECTIVE IN THE GASIFICATION OF CARBON SOLIDS AND THE OXIDATIVE COUPLING OF METHANE

H. Heinemann, G. A. Somorjai, and D. L. Perry Mar. 1992 14 p

(Contract DE-AC03-76SF-00098)

(DE93-001602; LBL-32005) Avail: CASI HC A03/MF A01

Work will continue on the oxidative coupling reaction of methane over ternary oxide catalysts to produce C2, C3, and C4 hydrocarbons and particularly olefins with high selectivity. The work which has shown that close to 100 percent selectivity can be obtained has received wide attention and has resulted in collaborative efforts with industry (CRADA) towards the development of a commercial process. An immediate purpose of additional work is to increase the conversion without diminishing the extremely high selectivity of the reaction and also to permit operation at higher space velocity to reduce equipment size. The mechanism of this reaction is not understood and much additional work is needed to explain the role of carbon formation and of water as intermediates in the reaction and to investigate whether carbon oxides are intermediates. It was found that oxides other than calcium-nickel-potassium oxides can be useful catalysts for this reaction in the presence of steam and at relatively low temperatures and long contact times. Better definition of the class of binary metal oxides is required and better catalyst characterization is needed to ensure reproducibility of catalyst preparation and operational results. Pretreatment of the catalyst should be shortened and higher space velocities must be obtained. Close collaboration with Orion ACT is required to advance the project toward the pilot plant stage. In the area of coal and char catalytic steam gasification, the large volume of data obtained at atmospheric pressure will be extended to operations at higher pressures. DOE

N93-15955# California Inst. of Tech., Pasadena. Dept. of Chemistry.

APPLICATION OF SCANNING TUNNELING MICROSCOPY TO ELECTROCHEMISTRY Report, Sep. 1988 - Sep. 1991

M. J. Heben, T. L. Longin, R. Pyllki, R. J. Penner, and R. Blumenthal 15 Sep. 1992 4 p

(Contract N00014-88-K-0482)

(AD-A255680) Avail: CASI HC A01/MF A01

Our efforts through the last contract period have involved the fundamental study of the STM imaging process, the investigation of the use of partially insulated STM tips as ultramicroelectrodes, and applications of STM for the generation of lithographic features. STM investigations of conducting polymers dispersed on graphite surfaces and doped with I2 revealed that, although the conducting backbone of the polymer could be imaged under a range of tunneling conditions, the non-conducting side groups of the polymer were not imaged. These images represent the first atomic resolution images of polymers, and studies of this studies of this type, involving the simultaneous imaging of nominally conducting and non-conducting groups, should prove essential in developing a theoretical understanding of the contrast mechanisms which dominate the imaging of individual adsorbed molecules with STM. Studies of ultramicroelectrodes, fabricated initially as partially insulated STM tips for use in solutions containing significant concentrations of electroactive species, have revealed the possibility of fabricating electrodes as small as one nanometer in diameter. GRA

N93-15963# Daresbury Nuclear Physics Lab. (England).
THE Ba-RELATED PARTIAL DENSITY OF STATES IN THERMIONIC DISPENSER CATHODES REVEALED BY RESONANT PHOTOEMISSION SPECTROSCOPY Final Report, 1 Sep. 1989 - 31 Aug. 1991
A. M. Awobode, B. C. Cowie, and D. Norman Aug. 1992 9 p
(Grant AF-AFOSR-0545-89)
(AD-A255710; DL/SCI/P821E) Avail: CASI HC A02/MF A01

A range of synchrotron radiation-based spectroscopies has been used to study the geometric and electronic structure of the sub-monolayer barium/oxygen coating on tungsten-based thermionic dispenser cathodes. Surface EXAFS (Extended X-ray Absorption Fine Structure) results are identical to those published by us earlier (Norman et al, Phys. Rev. Lett. 58 (1987) 519). Near edge XAFS shows substantial differences between the environment of oxygen atoms on B-type (pure W matrix) and CD-type (W/Os alloy) cathodes, but these results still await detailed understanding. Photoemission shows that the shape of the valence band also is distinctly different for the two types of cathode, consistent with a lower coverage BaO overlayer on the alloy cathode, and a somewhat higher coverage of BaO with excess oxygen on the B-type cathode. The binding energies of the Ba 5p3/2, 1/2, and O 2s levels reinforce this suggestion. Constant initial state spectra show a resonance at a photon energy of about 106 eV in the Ba 5p levels and in parts of the valence band lying at binding energies greater than ca. 3.5 eV, but there are no Ba-derived states within ca. 3.5 EV of the Fermi level. GRA

N93-15996# Dalhousie Univ., Halifax (Nova Scotia). Dept. of Physics.
THEORY OF FIELD ADSORPTION OF HYDROGEN
Xiaoming Ye, H. J. Kreuzer, and D. R. Salahub 6 Oct. 1992 23 p
(Contract N00014-80-J-1796)
(AD-A257139; TR-9) Avail: CASI HC A03/MF A01

Field effects on the adsorption characteristics of H, H2 and H3 on metals are calculated using density functional theory for a jellium metal and for small metal clusters. New dissociation channels are explored and a mechanism for the formation of a field-stabilized linear H3 species is proposed. GRA

N93-16012# Ames Lab., IA.
THERMAL ISOMERIZATION AND DECOMPOSITION OF ETHYNYLDISILANES Ph.D. Thesis
S. A. Petrich Jul. 1992 110 p
(Contract W-7405-eng-82)
(DE92-040578; IS-T-1351) Avail: CASI HC A06/MF A02

Co-pyrolysis of ethynylpentamethyldisilane with 2,3-dimethylbutadiene afforded trimethylsilylacetylene, dimethylsilyl (trimethylsilyl) acetylene and 1,1,3,4-tetramethyl 1-silacyclopent-3-ene. When an alkyl or trimethylsilyl substituted ethynyl group was pyrolyzed, extrusion of dimethylsilylene was the only decomposition process observed with no isomerization. The decomposition and isomerization pathways and Arrhenius parameters were determined for these processes by using a pulse stirred-flow reactor. Pyrolysis of ethynylundecamethyl cyclohexasilane afforded the ring-expanded isomer 3 hydridoundecamethyl hexasilacyclooctyne and decamethyl pentasilacycloheptyne. Pyrolysis of 4,4,5,5,6,6,7,7,8,8-decamethyl 4,5,6,7,8-pentasilacyclooctyne afforded ring-contracted isomer 1,1-penta (dimethylsilylene) propadiene, 4,4,5,5,6,6,7,7-octamethyl 4,5,6,7-tetrasilacycloheptyne, no. 1, and 1,1-tetra(dimethylsilylene) propadiene, no. 2. Cycloheptyne no. 1 was also pyrolyzed and afforded propadiene no. 2 as the only product. Several mechanisms were proposed for these decompositions and isomerizations. DOE

N93-16016# Ames Lab., IA.
C-13 SOLID-STATE NMR STUDY OF ETHYLENE OXIDATION OVER SUPPORTED SILVER CATALYSTS Ph.D. Thesis
S. Hosseini 21 Jul. 1992 130 p
(Contract W-7405-eng-82)
(DE92-040584; IS-T-1623) Avail: CASI HC A07/MF A02

Solid-state NMR has been used to study the interaction of ethylene with oxygen in the absence of promoters and moderators over silica-supported silver catalysts. Experiments using nitrous oxide and oxygen as the oxidants have been carried out over Ag/SiO2 catalysts at temperature ranging from 298 to 613 K. Standard cross-polarization with magic angle spinning (CP/MAS), CP/MAS with dipolar dephasing, and single-pulse experiments have been applied to identify carbon containing species that are formed on the surface of catalyst at various temperatures. Ethylene, acetic acid, carbon dioxide, ethane and an alkoxy species have been identified. Under the above experimental conditions, no ethylene oxide is detected by NMR. In pursuit of a better understanding of the chemistry taking place on the catalyst, silica-supported silver catalysts as well as pure silica were dosed with labeled ethylene, carbon dioxide and ethylene oxide. It was found that under conditions employed in this study, ethylene oxide reacts with both metal and silica support and thus can not be observed as the reaction product. Ethylene oxide, however, has been observed after saturation of silica surface with unlabeled ethylene oxide prior to ethylene oxidation. A multiport high vacuum glass apparatus was developed along with a single-coil double resonance probe. DOE

N93-16020# Ames Lab., IA.
FLUORESCENCE DETECTION FOR GEL AND CAPILLARY ELECTROPHORESIS Ph.D. Thesis
B. Hogan 21 Jul. 1992 125 p
(Contract W-7405-eng-82)
(DE92-040585; IS-T-1595) Avail: CASI HC A06/MF A02

First, an indirect fluorescence detection system for the separation of proteins via gel electrophoresis. Quantities as low as 50 nanograms of bovine serum albumin and soybean trypsin inhibitor are separated and detected visually without the need for staining of the analytes. This is very similar to levels of protein commonly separated with gel electrophoresis. DOE

N93-16037# California Univ., Santa Barbara. Dept. of Chemistry.
THE SYNTHESIS OF CHEMILUMINESCENT FLAVOABZYMES AND THEIR USE IN METAL ION DETECTION Final Report, 15 Mar. 1990 - 15 Sep. 1992
Thomas C. Bruice 2 Sep. 1992 10 p
(Contract N00014-90-J-1711)
(AD-A255567) Avail: CASI HC A02/MF A01

The ultimate goal of this research is to develop chemiluminescent (CL) abzymes and a technology for their use in metal ion detection. Four objectives must be reached in sequential order: (1) a molecule (hapten) which resembles in space requirements an intermediate in a CL reaction must be synthesized; (2) a hapten protein conjugate (antigen) must be prepared and used to obtain monoclonal antibodies (Mab's); (3) one or more of the Mab's must catalyze the given CL reaction; and (4) the hapten must be modifiable such that the CL Mab's become specific complexers of metal ions. Accomplishment of the 1st objective would provide the first Mab mimic of bioluminescence. Attempts to synthesize a hapten to generate Cl flavoabzymes is discussed as well as progress in the synthesis of a hapten to be used to prepare abzymes to catalyze the CL reaction of H2O2 with oxalate esters Monoclonal antibodies (Mab's); Abzymes; hapten; antigen; chemiluminescence (CL); and bioluminescence. GRA

N93-16144# Tennessee Univ., Knoxville. Dept. of Chemistry.
CAPILLARY LIQUID CHROMATOGRAPHY USING LASER-BASED AND MASS SPECTROMETRIC DETECTION
M. J. Sepaniak and K. D. Cook 1992 15 p

(Contract DE-FG05-86ER-13613)
(DE92-040524; DOE/ER-13613/36) Avail: CASI HC A03/MF A01

In the years following the 1986 seminal paper (J. Chromatogr. Sci., 24, 347-352) describing modern capillary zone electrophoresis (CZE), the prominence of capillary electrokinetic separation techniques has grown. A related electrochromatographic technique is micellar electrokinetic capillary chromatography (MECC). This report presents a brief synopsis of research efforts during the current 3-year period. In addition to a description of analytical separations-based research, results of efforts to develop and expand spectrometric detection for the techniques is reviewed. Laser fluorometric detection schemes have been successfully advanced. Mass spectrometric research was less fruitful, largely owing to personnel limitations. A regenerable fiber optic sensor was developed that can be used to remotely monitor chemical carcinogens, etc. DOE

N93-16158# Purdue Univ., West Lafayette, IN. Dept. of Chemistry.
PROBING REDOX-INDUCED MOLECULAR TRANSFORMATIONS BY ATOMIC-RESOLUTION SCANNING TUNNELING MICROSCOPY: IODIDE ADSORPTION AND ELECTROOXIDATION ON Au(111) IN AQUEOUS SOLUTION
Xiaoping Gao and Michael J. Weaver Oct. 1992 34 p
(Contract N00014-91-J-1409)
(AD-A257347; TR-131) Avail: CASI HC A03/MF A01

In-situ atomic-resolution scanning tunneling microscopy (STM) has been utilized on ordered Au(111) under electrode potential control in acidic aqueous solution to examine iodine adlayer structures formed by iodide electrooxidation as well as electrosorption. In the potential region, -0.3 to 0.4 V vs SCE, below where electrooxidation of solution iodide occurs, several distinct iodine adlayer structures were observed. At the most negative potentials, structures close to the hexagonal (3 x 3) R30 deg (Theta = 0.33) pattern are evident. The registry between the adlayer and the substrate lattice was deduced in part from composite domain images created by stepping the electrode potential so to alter markedly the adsorbate coverage during acquisition of a given STM image. At potentials between -0.2 and 0.2 V, adlayer patterns closer to the (5 x 3) (Theta = 0.4) structure became increasingly prevalent. This features a diminution in the iodine spacing along two of the three iodine rows, with a corresponding ca 5 deg shift from the R30 deg direction. Above 0.2 V, the STM images indicated the predominant presence of a more complex higher coverage adlayer (Theta = 0.44) featuring long range (19 + or -1 A) Z corrugations rotated by 8 to 10 deg from the hexagonal iodine adlattice. These corrugations arise from periodic alterations in the iodine binding site, necessitated by I-I distances that approach the van der Waals diameter. Above 0.3 V, however, poly-iodide chains were also observed, featuring shorter (2.8 to 3.2 A) I-I distances compatible with adsorbate-adsorbate chemical bonding; these increasingly distort the monomeric iodine superlattice structure. GRA

N93-16163# Colorado School of Mines, Golden. Dept. of Physics.
POTENTIAL MODULATION OF EQUILIBRIUM AND EXCITATION PHENOMENA AT THE ELECTROLYTE-SOLID INTERFACE
T. E. Furtak Oct. 1992 10 p
(Contract DE-FG02-86ER-45253)
(DE93-001685; DOE/ER-45253/7) Avail: CASI HC A02/MF A01

Optical SHG (second harmonic generation) is well suited for interfacial studies and for probing the electrolyte-solid interface. A series of experiments were completed on Ag(001). The bulk isotropic (gamma) and anisotropic (zeta) susceptibilities were determined and can be carried over to other Ag orientations. The only allowed surface susceptibility, (chi)(zxx), was negligible only as long as the surface was uncharged or negatively charged. To explain the results, a phenomenological model has been developed for four-field mixing; the static electrochemical field is a third 'incoming field' (together with the two optical SHG fields) that mix via a third-order surface susceptibility. The potential-induced surface reconstruction on Ag(111), attributed last year to adsorbed sulfate ions, was studied further; the reproducibility problem in the trend toward the fully reconstructed surface continued to be found. Alternate explanations for the apparent symmetry change are being explored. The detection system on the surface Raman facility was improved. DOE

N93-16195# Oak Ridge National Lab., TN.
MICROPARTICLE-BASED FLUORESCENCE IMMUNOASSAY
W. B. Whitten, J. M. Ramsey, and B. V. Bronk (Army Chemical Research and Development Center, Aberdeen Proving Ground, MD.) 1992 9 p Presented at the US Army Chemical Research Development Engineering Center (CRDEC) Conference on Obscuration and Aerosol Research, Aberdeen Proving Grounds, MD, 22-26 Jun. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040704; CONF-9206274-1) Avail: CASI HC A02/MF A01

We have recently shown that it is possible to detect single molecules of highly fluorescent dyes. However, there are a large number of compounds of practical interest that are either nonfluorescent or, if fluorescent, the emission spectrum is not sufficiently distinctive to give useful analytical specificity. One way to achieve very high sensitivity and selectivity is to attach a fluorescent label to the analyte molecule via an antibody-antigen reaction. We have undertaken some experiments to explore the utility of immunofluorescence techniques in conjunction with our microparticle fluorescence measurements for the detection of biologically important substances. DOE

N93-16227# Westinghouse Savannah River Co., Aiken, SC.
ADSORPTION OF A BINARY GAS MIXTURE WHICH LATERALLY INTERACTS ON A RANDOM HETEROGENEOUS SURFACE
J. A. Ritter 1992 26 p Presented at the American Institute of Chemical Engineers Annual Meeting, Miami, FL, 1-6 Nov. 1992
(Contract DE-AC09-89SR-18035)
(DE93-000706; WSRC-MS-92-332; CONF-921104-5) Avail: CASI HC A03/MF A01

Analytical expressions for the adsorption of a binary gas mixture which laterally interacts on a heterogeneous surface are developed. The lateral interactions are of the Bragg-Williams type and the surface heterogeneity is modeled via a random distribution of sites described by a uniform distribution of Henry's Law constants. The parametric study shows that complex phase behavior can be predicted, including azeotropes and sigmoidal shaped X-Y diagrams. Also, this model may be useful for modeling and designing adsorption processes as it requires few iterations to simultaneously solve the implicit and coupled algebraic expressions. DOE

N93-16389*# North Carolina State Univ., Raleigh.
MODELING OF TURBULENT SUPERSONIC H2-AIR COMBUSTION WITH AN IMPROVED JOINT BETA PDF
R. A. Baurle and H. A. Hassan 1991 9 p
(Grants NAG1-244; NAGw-1331)
(NASA-CR-191929; NAS 1.26:191929) Avail: CASI HC A02/MF A01

Attempts at modeling recent experiments of Cheng et al. indicated that discrepancies between theory and experiment can be a result of the form of assumed probability density function (PDF) and/or the turbulence model employed. Improvements in both the form of the assumed PDF and the turbulence model are presented. The results are again used to compare with measurements. Initial comparisons are encouraging. Author

N93-16462 Department of the Navy, Washington, DC.
ANNULAR VORTEX COMBUSTOR Patent
Sen Nieh, inventor (to Navy) and Tim T. Fu, inventor (to Navy) 23 Jun. 1992 8 p Filed 25 Nov. 1991
(AD-D015462; US-Patent-5,123,361; US-Patent-Appl-SN-805722; US-Patent-Class-110-264) Avail: US Patent and Trademark Office

An apparatus for burning coal water fuel, dry ultrafine coal, pulverized coal and other liquid and gaseous fuels including a vertically extending outer wall and an inner, vertically extending cylinder located concentrically within the outer wall, the annular space between the outer wall and the inner cylinder defining a combustion chamber and the all space within the inner cylinder defining an exhaust chamber. Fuel and atomizing air are injected tangentially near the bottom of the combustion chamber and secondary air is introduced at selected points along the length of the combustion chamber. Combustion occurs along the spiral flow path in the combustion chamber and the combined effects of centrifugal, gravitational and aerodynamic forces cause particles of masses or sizes greater than the threshold to be trapped in a stratified manner until completely burned out. Remaining ash particles are then small enough to be entrained by the fuel gas and exit the system via the exhaust chamber in the opposite direction. GRA

N93-16473# Technische Univ., Eindhoven (Netherlands).
PREPARATION AND EVALUATION OF FUSED SILICA CAPILLARY COLUMNS FOR GAS CHROMATOGRAPHY AND MICELLAR ELECTROKINETIC CHROMATOGRAPHY Ph.D. Thesis
Quanji Wu 1992 191 p
(ETN-92-92818) Avail: CASI HC A09/MF A02

Recent developments in methods of deactivation and crosslinking of the stationary phases for fused silica capillary columns are described. The experimental study of the deactivation process is supported by solid state Si-29 Nuclear Magnetic Resonance (NMR) measurements on model substrates like fumed silica. Columns prepared following optimized procedures are evaluated by applications both in capillary Gas Chromatography (GC) and electrokinetic chromatography. The deactivation of fused silica capillary columns by polyhydrosiloxanes with different functional substituents is described. A study of the deactivation process of silica surface using nonporous silica particles as the model substrate by Si-29 NMR is described. The preparation of nonpolar and medium polar capillary columns for GC is described, using the optimized deactivation. The applicability of the prepared nonpolar and medium polar fused capillary columns in GC is illustrated. A systematic investigation of the electroosmotic flow in Micellar Electrokinetic Capillary Chromatography (MECC) was carried out. MECC is applied for the separation of a number of chlorophenoxy acid herbicides. ESA

N93-16582# Technische Univ., Delft (Netherlands).
PRECISION AND RESOLUTION IN SPECTROSCOPIC MODEL FITTING Ph.D. Thesis
Joost Herman Swarte 1992 213 p
(ISBN-90-6275-756-6; ETN-92-92786) Copyright Avail: CASI HC A10/MF A03

The effects of errors of observation on the solutions of spectroscopic model fitting are studied. The spectroscopic model consists of a weighted sum of peak shapes of the same nonlinearly parametric family. Three effects were distinguished: displacement of the solution leading to imprecision, interchange of the geometrical proportions of the peaks and coincidence of the solutions preventing resolution of close peak parameters. A hypersurface that divides the space of errors of observation into two parts is defined for each effect. Errors of observation located in the part containing the origin do not cause effects, errors located in the other part do. The distance from the origin to the hypersurface is called the critical norm. Errors of observation having a smaller norm can not cause the effect in question. The hypersurface can be approximated by a hyperplane to help find in which part particular errors of observation are located. If the errors of observation are statistical, the probability of occurrence of the effect can be computed. Numerical experiments with spectroscopic models show that the theory can be used in practice. ESA

N93-16585# Minnesota Univ., Minneapolis. Dept. of Chemistry.
THE CONTRIBUTION OF ELECTRONICALLY EXCITED STATES TO THE RADIATION CHEMISTRY OF ORGANIC SYSTEMS
S. Lipsky 1992 11 p
(Contract DE-FG02-85ER-13404)
(DE92-040465; DOE/ER-13404/7) Avail: CASI HC A03/MF A01

At low concentrations (less than or = 10(exp -3)M) aromatic solutes in saturated hydrocarbon solvents, very efficient transport of electronic energy from photo-excited solvent to aromatic is observed. Effects of temperature, dilution, and quenching additives are being studied. Two-photon pulsed laser excitation gives no evidence of long lived metastable states. The fluorescence quantum yields of saturated hydrocarbon liquids have been studied for excitation wavelengths from 200 to 120 nm. For many compounds, the quantum yields for fluorescence are observed to decline to a minimum value at, or near, previously reported ionization thresholds. At higher energies, the magnitude of the quantum yield for fluorescence begins to increase. Magnetic field effects on intensity of steady-state recombination fluorescence have been observed both for photo-generated and Beta(-) generated, electron and positive ion geminate pairs in saturated hydrocarbon liquids. The comparison indicates an important contribution, to observed recombination fluorescence from multiple ion-pairs under radiation chemical conditions. For photo-excited aromatic solutes dissolved in saturated hydrocarbon liquids, no magnetic field effect could be observed until surprisingly large excess energies above the threshold for ionization were achieved. This suggests a much smaller average range for the thermalized electron than expected from photoconductivity. DOE

N93-16586# National Inst. of Standards and Technology, Gaithersburg, MD. Molecular Physics Div.
SPECTROSCOPIC INVESTIGATION OF THE VIBRATIONAL QUASI-CONTINUUM ARISING FROM INTERNAL ROTATION OF A METHYL GROUP
J. T. Hougen 1991 3 p
(Contract DE-AI05-90ER-14161)
(DE92-040509; DOE/ER-14161/1) Avail: CASI HC A01/MF A01

The goal was to use spectroscopic techniques to study in detail phenomena involving the vibrational quasicontinuum in a simple physical system. Acetaldehyde was chosen because: (1) methyl groups are known to be important promotors of intramolecular vibrational relaxation; (2) the internal rotation of a methyl group is an easily describable large-amplitude motion, which should retain its simple character even at high levels of excitation; and (3) the aldehyde carbonyl group offers the possibility of both vibrational and electronic probing. The present study of the ground electronic state has three parts: (1) understanding the 'isolated' internal-rotation motion below, at, and above the top of the torsional barrier; (2) understanding in detail traditional vibrational fundamental and overtone states; and (3) understanding interactions involving states with multiquantum excitations of at least one of these two kinds of motion. Progress during the first nine months of this project is described under these three headings. DOE

N93-16589# Georgia Inst. of Tech., Atlanta. School of Physics.
FIRST-PRINCIPLES STUDIES OF PHASE STABILITY AND THE STRUCTURAL AND DYNAMICAL PROPERTIES OF METAL HYDRIDES
M. Y. Chou Apr. 1992 12 p
(Contract DE-FG05-90ER-45431)
(DE92-040855; DOE/ER-45431/2) Avail: CASI HC A03/MF A01

The following topics are discussed: Calculation of the Structural Properties of Yttrium; Dynamical and pairing properties of alpha-YH(chi); Electronic and structural properties of YH2 and YH3; Phase diagram of hydrogen on Ru(000); Peierls distortion in hexagonal YH3; and Study of hydrogen in niobium and palladium. DOE

N93-16614*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LSENS, A GENERAL CHEMICAL KINETICS AND SENSITIVITY ANALYSIS CODE FOR GAS-PHASE REACTIONS: USER'S GUIDE
Krishnan Radhakrishnan (Sverdrup Technology, Inc., Brook Park, OH.) and David A. Bittker Jan. 1993 210 p
(RTOP 505-62-21)
(NASA-TM-105851; E-7299; NAS 1.15:105851) Avail: CASI HC A10/MF A03

A general chemical kinetics and sensitivity analysis code for complex, homogeneous, gas-phase reactions is described. The main features of the code, LSENS, are its flexibility, efficiency and convenience in treating many different chemical reaction models. The models include static system, steady, one-dimensional, inviscid flow, shock initiated reaction, and a perfectly stirred reactor. In addition, equilibrium computations can be performed for several assigned states. An implicit numerical integration method, which works efficiently for the extremes of very fast and very slow reaction, is used for solving the 'stiff' differential equation systems that arise in chemical kinetics. For static reactions, sensitivity coefficients of all dependent variables and their temporal derivatives with respect to the initial values of dependent variables and/or the rate coefficient parameters can be computed. This paper presents descriptions of the code and its usage, and includes several illustrative example problems. Author

N93-16647*# Pennsylvania State Univ., University Park. Propulsion Engineering Research Center.
COMBUSTION OF LOX WITH H2(SUB g) UNDER SUBCRITICAL, CRITICAL, AND SUPERCRITICAL CONDITIONS AND EXPERIMENTAL OBSERVATION OF DENSE SPRAY AND MIXING OF IMPINGING JETS Semiannual Report, 1 Feb. - 31 Oct. 1992
Kenneth K. Kuo, W. H. Hsieh, A. S. Yang, J. J. Brown, F. B. Cheung, R. D. Woodward, and M. C. Kline Nov. 1992 63 p

(Grant NAG8-174)
(NASA-CR-191222; NAS 1.26:191222) Avail: CASI HC A04/MF A01

Progress made during the period of February 1 to October 15, 1992 is reported. The overall objective of Task 1 of the investigation is to achieve a better understanding of the combustion processes of liquid oxygen and gaseous hydrogen under subcritical, critical, and supercritical conditions. Specific objectives of the research program are: (1) to determine the evaporation- and burning-rate characteristics of LOX in hydrogen/helium environments under broad ranges of operating conditions; (2) to measure species concentration profile and surface temperature of LOX employing the gas chromatography and fine-wire thermocouples under non-reacting flow situations; (3) to perform a fugacity-based multicomponent thermodynamic phase equilibrium analysis for examining the high-pressure vapor-liquid equilibrium behavior at the liquid surface of LOX; (4) to formulate and solve a theoretical model for simulating the evaporation and combustion processes in a LOX/H2/He system; and (5) to validate the theoretical model with the measured experimental data. Task 2 of the investigation is described. Observation of a like-on-like injector element in the near-injector region performed in the previous phase of this project has identified the existence of a high Reynolds number regime in which the pre-impingement jets are fully turbulent and undergoing surface breakup. The new spray regime, which has not been observed by previous investigators, is characterized by the presence of many fine droplets and the disappearance of the well-defined liquid breakup wave pattern in the post-impingement region. It is speculated that a cavitating region may be present within the orifice so that it could induce strong turbulence, leading to an onset of atomization of the jets prior to impingement. To further investigate the dense spray behavior of the impinging jets in the high Reynolds number region, experiments were conducted using Plexiglas injector components for direct internal flow observation. The main objective is to determine under what conditions a cavitating region would form and whether or not the cavitation is reponsible for the development of the high Reynolds number spray regime. The procedure and major findings of the injector cavitation study are described. Author

N93-16656# Sandia National Labs., Albuquerque, NM.
THERMAL DIFFUSION PROCESSES IN AQUEOUS SODIUM CHLORIDE SOLUTIONS
R. T. Cygan and G. D. Jarrell (ManTech Environmental Technology, Inc., Corvallis, OR.) 18 Aug. 1992 36 p
(Contract DE-AC04-76DP-00789)
(DE93-002596; SAND-92-1275) Avail: CASI HC A03/MF A01

The experimental results for the Soret coefficients are variable, but suggest a trend with NaCl concentration that is consistent with electrolyte solution behavior. The temperature dependence of the Soret coefficients is in approximate agreement with previous measurements obtained using other techniques. In general, the Soret coefficient values are best interpreted based on the expansion of the fluid inclusion migration fields. The high temperature values for sigma at 1.0 N NaCl concentration suggest an expansion of the migration field to smaller inclusion sizes, which for a single halite crystal at these conditions, approach a dimension of one micron. The corresponding fluid inclusion size for the polycrystalline material, where grain boundaries retard the migration, is approximately 10 microns. Although the Soret results obtained in the present study provide additional data for high temperature applications in nuclear waste isolation, more experimentation and new equipment design are required in order to obtain data at temperatures above 80 C. The experimental approach utilized in this study is limited in that respect. The almost immeasurable nature of the thermal diffusion process for the brines as examined in the laboratory, suggests that this effect will be insignificant (outside of fluid inclusion migration) in most rock-water interactions associated with a rocksalt nuclear waste repository. Other effects, such as convective fluid transport, pressure solution, and groundwater flow, will be orders-of-magnitude more important in evaluating the critical nature of brine migration, waste canister corrosion, and the potential for leaching radioisotopes from waste repositories. DOE

N93-16728# Concordia Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
PRELIMINARY DEFINITION OF EXPERIMENTS AND PROCEDURES FOR TERRESTRIAL AND SPACE EXAMINATION OF FLAME STRUCTURE Final Report
Aaron Jaan Saban 31 Mar. 1990 83 p
(Contract DSS-31016-9-6058/01-SW)
(APRL-X13-8; CTN-93-60606) Avail: CASI HC A05/MF A01

Experiments and procedures were defined for use both terrestrially and in space to address the problem of combustion behavior in milli- or micro-gravity environments. It was proposed to have the experiments satisfy the following criteria: identical initial and boundary conditions to previously run experiments or standards; portability; design using acceptable space hardware; availability of previous models using established fluid mechanical and/or combustion techniques; and capability of being run on earth, on a KC-135, and in space. The Wolfhard-Parker slot burner, operating at atmospheric pressure, was selected for further research. Propane was selected as the fuel for its convenience and most of the work is being planned for the fuel-lean regime to reduce the likelihood of sooting. A detailed discussion is provided of the possibilities for laser induced fluorescence excitation generally and of sooting in hydrocarbon flames, as well as an estimate of the order of magnitude of Coriolis effects. It is suggested that a self-contained burner and data acquisition system be designed and used in a simulation of microgravity on a KC-135 flight in order to observe whether there is any significant change in combustion behavior in reduced gravity environments. Author (CISTI)

N93-16854 Tel-Aviv Univ. (Israel). School of Chemistry.
DEMONSTRATION OF A METHOD FOR EXTRACTING 2D NMR INFORMATION FROM A REDUCED SET OF SELECTED 1D EXPERIMENTS M.S. Thesis
Itamar Ronen Oct. 1990 58 p
(ITN-93-85183) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

A method was developed and demonstrated for using a reduced set of 1D (1-dimensional) experiments to extract the peak amplitudes of a 2D (2-dimensional) NMR (nuclear magnetic resonance) spectrum. The method, which has advantages over the usually used 2D Fourier transform (FT) method, is based on the solution of a linear set of equations for which the coefficient matrix includes signal-dependent and experiment-dependent elements. The free elements vector is derived from the experimental data. The method presented, which relies on a realistic model for the FID (time domain signal) and uses a non-linear optimization of the coefficient matrix, can allow the use of a very compact set of equations, which reduces the experimental time of a typical 2D experiment by at least an order of magnitude. In the first part of the thesis, the mathematical theory, as applied to a 1D experiment, is presented, including some simulated examples. The method is then expanded to deal with the 2D case. The impact of experimental noise and modeling errors on the calculated results is qualitatively discussed. The method was applied to two sets of experimental data. In the case of a simple chemical exchange system, in which the facilitated transport of lithium ions across phospholipid vesicles was measured, a shift reagent was used to provide differentiation of the resonances of the intravesicular and the extravesicular lithium ions. The resulting 2D spectrum included four peaks, whose integrals were calculated using 2D-FT data and compared with those derived by the optimized calculation performed on a reduced set of 1D experiments selected from the same experiment. Author (ISA)

N93-17000*# Alabama Univ., Huntsville. In-Line Process Control Lab.
MATERIALS SURFACE CONTAMINATION ANALYSIS Final Report
Gary L. Workman and William F. Arendale 1 Nov. 1992 85 p
(Contract NAS8-38609)
(NASA-CR-191417; NAS 1.26:191417) Avail: CASI HC A05/MF A01

The original research objective was to demonstrate the ability of optical fiber spectrometry to determine contamination levels on solid rocket motor cases in order to identify surface conditions which may result in poor bonds during production. The capability of using the spectral features to identify contaminants with other sensors which might only indicate a potential contamination level provides a real enhancement to current inspection systems such as Optical Stimulated Electron Emission (OSEE). The optical fiber probe can easily fit into the same scanning fixtures as the OSEE. The initial data obtained using the Guided Wave Model 260 spectrophotometer was primarily focused on determining spectra of potential contaminants such as HD2 grease, silicones, etc. However, once we began taking data and applying multivariate analysis techniques, using a program that can handle very large data sets, i.e., Unscrambler 2, it became apparent

that the techniques also might provide a nice scientific tool for determining oxidation and chemisorption rates under controlled conditions. As the ultimate power of the technique became recognized, considering that the chemical system which was most frequently studied in this work is water + D6AC steel, we became very interested in trying the spectroscopic techniques to solve a broad range of problems. The complexity of the observed spectra for the D6AC + water system is due to overlaps between the water peaks, the resulting chemisorbed species, and products of reaction which also contain OH stretching bands. Unscrambling these spectral features, without knowledge of the specific species involved, has proven to be a formidable task. Author

N93-17015# Rome Univ. (Italy). Dipt. di Fisica.
QCD SPECTROSCOPY AND PHENOMENOLOGY WITH IMPROVED ACTIONS
V. Vladikas (Tor Vergata Univ., Rome, Italy) 22 Jan. 1992 4 p Repr. of Nuclear Physics B (Proc. Suppl.), v. 30, 1992 p 1-3 Presented at Lattice, Tsukuba, Japan, 5-9 Nov. 1991
(Preprint-857; ETN-93-92959) Avail: CASI HC A01/MF A01

A numerical study of the Quantum Chromodynamics (QCD) phenomenology using the 'Clover' action, is presented. The QCD mass spectrum is studied using a next to nearest neighbor action. The investigation applies a low statistics study on a 20 by 100 by 40 lattice at beta = 6.0 of several quantities (160 configurations). Several configurations were also calculated at beta = 5.7. In order to investigate systematically the O(a) effects, both the standard Wilson action and the 'Clover' action on the same quenched configurations are used. The purpose of the work is to study the effects of improvement on the QCD lowest lying mass spectrum and its scaling. Both actions have the advantage of eliminating O(a) effects. ESA

N93-17066# Department of Energy, Morgantown, WV. Energy Technology Center.
NETWORKING ELECTROCHEMICAL MEMBRANE SEPARATION DEVICES: THEORY AND APPLICATION
J. G. Wimer, M. C. Williams, D. H. Archer (Carnegie-Mellon Univ., Pittsburgh, PA.), and J. F. Osterle (Carnegie-Mellon Univ., Pittsburgh, PA.) 1992 10 p Presented at the American Institute of Chemical Engineers Annual Meeting, Miami, FL, 1-6 Nov. 1992
(DE93-001381; DOE/METC-C/93/7031; CONF-921104-6) Avail: CASI HC A02/MF A01

Two of the most promising applications for electrochemical membranes are fuel cells and separation devices. In a fuel cell, fuel and oxidant flow on opposite sides of an ionically conductive membrane. An electrochemical potential is generated between electrodes which are mounted on either side of the membrane. Fuel cells take advantage of this electrochemical potential to generate electrical work. Conversely, electrochemical membrane separation devices (EMSDS) consume electrical energy as they remove selected species from a gas stream. When voltage is supplied between the electrodes on opposite sides of a separation membrane, ions carry the species to be removed from one side of the membrane to the other. Although these applications are quite different, their general operation is based upon the same electrochemical principles. Consequently, electrochemical membranes which have been developed for fuel cells can easily be adapted for use in separation devices. Likewise, the concept of networking electrochemical membranes, which is currently being developed to boost the efficiency of molten carbonate fuel cell systems, can also e applied to EMSDS. Networks, which are more effective than individual net operations, have been widely used in the process industries. In the context of this paper, networking is defined as ducting process streams such that they flow through electrochemical membrane devices in series. DOE

N93-17186# Energy Research Corp., Danbury, CT.
DEVELOPMENT OF AN ELECTROCHEMICAL HYDROGEN SEPARATOR
S. Abens, J. Fruchtman, and A. Kush 1992 11 p Presented at the US Department of Energy Contractors Review Meeting on Gasification and Gas Stream Cleanup Systems, Morgantown, WV, 15-17 Sep. 1992
(Contract DE-AC21-89MC-26040)
(DE93-002606; DOE/MC-26040/93/C0098; CONF-920951-7) Avail: CASI HC A03/MF A01

The electrochemical hydrogen separator (EHS), under development at ERC, has several attractive features: The operating temperature (150-200 C) is higher than those associated with the currently available devices and is compatible with the low temperature shift reactors. The EHS can operate at atmospheric as well as elevated pressures and the product H2 is available at the feed stream pressure. Ninety percent H2 recovery from feed streams containing less than 10 percent hydrogen is feasible. The product H2 purity is greater than 98 percent (dry basis) and is virtually independent of H2 concentration in the feed gas. The process is continuous. Depending upon the operating conditions, the energy requirement varies between 2 to 6 kWh/1000 SCF of recovered hydrogen. DOE

N93-17212# SRI International Corp., Menlo Park, CA. Molecular Physics Lab.
COMBUSTION RESEARCH PROGRAM: FLAME STUDIES, LASER DIAGNOSTICS, AND CHEMICAL KINETICS
D. R. Crosley Sep. 1992 24 p
(Contract DE-FG03-86ER-13571)
(DE93-002758; DOE/ER-13571/T2) Avail: CASI HC A03/MF A01

This project has comprised laser flame diagnostic experiments, chemical kinetics measurements, and low pressure flame studies. Collisional quenching has been investigated for several systems: the OH radical, by H2O in low pressure flames; the rotational level dependence for NH, including measurements to J = 24; and of NH2 at room temperature. Transition probability measurements for bands involving v' = 2 and 3 of the A-X system of OH were measured in a flame. Laser-induced fluorescence of vinyl radicals was unsuccessfully attempted. RRKM and transition state theory calculations were performed on the OH + C2H4 reaction, on the t-butyl radical + HX; and transition state theory has been applied to a series of bond scission reactions. OH concentrations were measured quantitatively in low pressure H2/N2O and H2/O2 flames, and the ability to determine spatially precise flame temperatures accurately using OH laser-induced fluorescence was studied. DOE

N93-17348# Ames Lab., IA.
INSTRUMENTAL AND THEORETICAL DEVELOPMENT OF CAPILLARY ELECTROPHORESIS AND ITS APPLICATION TO BIOLOGICAL SYSTEMS Ph.D. Thesis
T. T. Lee Sep. 1992 254 p
(Contract W-7405-eng-82)
(DE93-001220; IS-T-1629) Avail: CASI HC A12/MF A03

Essential aspects of capillary electrophoresis (CE) are outlined. By integrating the electrophoretic current during electromigration, a migration index and an adjusted migration index are used to compare results obtained under changing conditions (constant and gradient fields, capillary lengths, inner diameters, zeta-potentials). Except for inner diameter cases, the indices are superior to all other indicators, and the qualitative precision of migration data is improved. Integration of the current during injection raises the quantitative precision of manual electrokinetic injection to the levels attained with hydrodynamic injection. A model based on field-amplified CE is proposed to describe the electrokinetic injection process involving samples with distinct conductivities and an equation is developed to allow normalization of peak areas at the 1-5 percent level without the need for quantitative internal standardization. Experiments reveal that the model is valid when electromigration is the predominant mode of migration during injection. Design and performance of a rugged, compact, user-friendly and easily constructed laser-induced fluorescence (LIF) detector for CE are presented. DOE

N93-17356# Argonne National Lab., IL.
SUPRAMOLECULAR STRUCTURES MODELING PHOTOSYNTHETIC REACTION CENTER FUNCTION
M. R. Wasielewski, G. L. Gaines, III, D. Gosztola, M. P. Niemczyk, and W. A. Svec 20 Aug. 1992 7 p Presented at the 9th International Congress on Photosynthesis, Nagoya, Japan, 30 Aug. - 5 Sep. 1992
(Contract W-31-109-eng-38)
(DE92-041123; ANL/CP-76566; CONF-9208155-1) Avail: CASI HC A02/MF A01

Work in our laboratory has focused on the influence of solvent motion on the rates and energetics of photochemical charge separation in glassy solids. The efficiencies of many nonadiabatic electron transfer reactions involving photochemical electron donors with relatively low excited state energies, such as porphyrins and chlorophylls, are poor in the solid state. Recent work has shown that placing a porphyrin-acceptor system in a

glassy solid at low temperature significantly raises the energy of its ion-pair state. This destabilization can be as much as 0.8 eV relative to the ion pair state energy in a polar liquid. This contrasts sharply with photosynthetic reaction centers, which maintain medium-independent electron transfer rates with relatively small free energies of charge separation. Using this information we have set out to design photochemical systems that produce long-lived radical ion pairs in glassy solids with high quantum efficiency. These systems maintain their efficiency when placed in other glassy matrices, such as polymers. An important consequence of this effort is the design of molecules that minimize the electronic interaction between the oxidized donor and reduced acceptor. This minimization can be attained by careful design of the spacer groups linking the donor and acceptor and by using more than a single electron transfer step to increase the distance between the separated charges as is done in natural photosynthesis. DOE

N93-17358# California Univ., Berkeley. Lawrence Berkeley Lab.
SEPARATION OF COMPOUNDS WITH MULTIPLE -OH GROUPS FROM DILUTE AQUEOUS SOLUTIONS VIA COMPLEXATION WITH ORGANOBORONATE Ph.D. Thesis
Tina Kuo Fung Chow May 1992 80 p
(Contract DE-AC03-76SF-00098)
(DE92-041201; LBL-32430) Avail: CASI HC A05/MF A01

The complexing extractant agent investigated in this work is 3-nitrophenylboronic acid (NPBA) in its anionic form (NPB). NPBA and Aliquat 336 (quaternary amine) are dissolved in 2-ethyl-1-hexanol, and the extractant is contacted with aq. NaOH. Solutes investigated were 1,2-propanediol, glycerol, fructose, sorbitol, and lactic acid. Batch extraction experiments were performed at 25 C. Partition coefficients, distribution ratios, and loadings are reported for varying concentrations of solute and NPB. All solutes showed complexation with NPB(-), with all complexes containing only one NPB(-) per complex. The 1:1 complexation constants for the solutes glycerol, fructose and sorbitol follow trends similar to complexation with B(OH)(4)(-) (aq.), i.e. the complexation constants increase with increasing number of (-)OH groups available for complexation. Assumption of 1:1 complex is not valid for 1,2-propanediol, which showed overloading (more than one mole of solute complexed to one mole NPB(-) at higher concentrations). The (-)OH group on the NPB(-) which is left uncomplexed after one solute molecule had bound to the other two (-)OH groups may be responsible for the overloading. Overloading is also observed in extraction of tactic acid, but through a different mechanism. It was found that TOMA(+) can extract lactic acid to an extent comparable to the uptake of lactic acid by NPB(-). The complexation is probably through formation of an acid-base ion pair. Losses of NPBA into the aqueous phase could lead to problems, poor economics in industrial separation processes. One way of overcoming this problem would be to incorporate the NPBA onto a solid support. DOE

N93-17407*# Eloret Corp., Sunnyvale, CA.
COMPUTED POTENTIAL ENERGY SURFACES FOR CHEMICAL REACTIONS Semiannual Report, 1 Jul. - 31 Dec. 1992
K. Heinemann (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.), Stephen P. Walch (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.), and Eugene Levin 22 Jan. 1993 40 p
(Contract NCC2-478)
(NASA-CR-191804; NAS 1.26:191804) Avail: CASI HC A03/MF A01

A manuscript describing the calculations on the (1)CH2 + H2O, H2 + HCOH, and H2 + H2CO product channels in the CH3 + OH reaction, which were described in the last progress report, has been accepted for publication in J. Chem. Phys., and a copy of the manuscript is included in the appendix. The production of (1)CH2 in this reaction is important in hydrocarbon combustion since (1)CH2 is highly reactive and would be expected to insert into N2, possibly leading to a new source for prompt NO(x) (vide infra). During the last six months new calculations have been carried out for the NH2 + NO system, which is important in the thermal de-NO(x) process. For individual titles, see N93-17408 through N93-17409.

N93-17408*# Eloret Corp., Sunnyvale, CA.
THEORETICAL CHARACTERIZATION OF THE REACTION CH3 +OH YIELDS CH3OH YEILDS PRODUCTS: THE (1)CH2 + H2O, H2 + HCOH, AND H2 + H2CO CHANNELS
Stephen P. Walch *In its* Computed Potential Energy Surfaces for Chemical Reactions 22 Jan. 1993 23 p (For primary document see N93-17407 05-25)
(Contract NCC2-478)
Avail: CASI HC A03/MF A01

The potential energy surface (PES) for the CH3OH system has been characterized for the (1)CH2 + H2O, H2 + HCOH, and H2 + H2CO product channels using complete-active-space self-consistent-field (CASSCF) gradient calculations to determine the stationary point geometries and frequencies followed by CASSCF/internally contracted configuration-interaction (CCI) calculations to refine the energetics. The (1)CH2 + H2O channel is found to have no barrier. The long range interaction is dominated by the dipole-dipole term, which orients the respective dipole moments parallel to each other but pointing in opposite directions. At shorter separations there is a dative bond structure in which a water lone pair donates into the empty a' orbital of CH2. Subsequent insertion of CH2 into an OH bond of water have barriers located at -5.2 kcal/mol and 1.7 kcal/mol, respectively, with respect to CH3 + OH. From comparison of the computed energetics of the reactants and products to known thermochemical data it is estimated that the computed PES is accurate to plus or minus 2 kcal/mol. Author

N93-17409*# Eloret Corp., Sunnyvale, CA.
COMPUTED BARRIER HEIGHTS FOR H + CH2O YIELDS CH3O YIELDS CH2OH
Stephen P. Walch *In its* Computed Potential Energy Surfaces for Chemical Reactions 22 Jan. 1993 8 p (For primary document see N93-17407 05-25)
(Contract NCC2-478)
Avail: CASI HC A02/MF A01

The barrier heights (including zero-point effects) for H + CH2O yields CH3O and CH3O yields CH2OH have been computed using complete active space self consistent field (CASSCF)/gradient calculations to define the stationary point geometries and harmonic frequencies and internally contracted configuration-interaction (CCI) to refine the energetics. The computed barrier heights are 5.6 kcal/mol and 30.1 kcal/mol, respectively. The former barrier height compares favorably to an experimental activation energy of 5.2 kcal/mol. Author

N93-17461# Pacific Northwest Lab., Richland, WA.
EFFECTS OF DELOCALIZATION ON INTRINSIC BARRIERS FOR H-ATOM TRANSFER: IMPLICATIONS FOR THE RADICAL HYDROGEN TRANSFER REACTION
D. M. Camaioni, S. T. Autrey, K. F. Ferris, and J. A. Franz Aug. 1992 5 p Presented at the 6th Organic Free Radicals Symposium, Noordwijkerhout, Netherlands, 23-28 Aug. 1992
(Contract DE-AC06-76RL-01830)
(DE93-001565; PNL-SA-21119; CONF-9208170-1) Avail: CASI HC A01/MF A01

PM3 calculations of transition states (TS) for both normal H-atom transfer and radical hydrogen transfer (RHT) reactions of a wide-variety of hydrocarbon structures have enabled development of quantitative structure-reactivity relationships. Results indicate that activation barriers for RHT reactions are large enough that thermoneutral and endothermic reactions should not compete with alternative multistep pathways. DOE

N93-17675# Iowa Univ., Iowa City.
A BIOTECHNICAL APPROACH TO STUDIES ON THE BIODEGRADATION OF CHLOROBENZENES AND TRICHLOROETHYLENE Final Report, 1 Sep 1988 - 31 May 1992
David T. Gibson Oct. 1992 9 p
(Grant AF-AFOSR-0225-88)
(AD-A258033; DOT/FAA/PP-92-5; AFOSR-92-0965TR) Avail: CASI HC A02/MF A01

The absolute stereochemistry of the chiral dihydrodiols formed from ortho- and meta-dichlorobenzene were determined. Both diols were found to be enantiomerically pure with 1S,2S absolute configuration. Toluene-grown cells of Pseudomonas putida F1 and Pseudomonas sp. JS150 were found to oxidize 2- and 3-nitrotoluene to benzyl alcohols. These results represent the first demonstration of the oxidation of a methyl substituent by toluene dioxygenase. Both organisms oxidized 4-nitrotoluene to 2-methyl-5-nitrophenol and 3-methyl-6-nitrocatechol. The significance of these unexpected results was evaluated. GRA

N93-17693# Naval Postgraduate School, Monterey, CA.
IR IMAGING FOR COMBUSTION CHARACTERISTICS AND OPTICAL PROPERTIES OF BORON/BORON OXIDE M.S. Thesis
Yang Jen-Cheng Jun. 1992 42 p
(AD-A257747) Avail: CASI HC A03/MF A01

An experimental investigation was conducted to determine if a new high speed IR microscope could be used to study the ignition and combustion characteristics of boron/boron carbide and to measure the particle emissivity as a function of temperature. Air heater limitations did not permit the investigation of ignition characteristics. Emissivity in the 2-5 micron band was measured as a function of temperature using a small boron filament. Data obtained using different IR band-pass filters resulted in significantly different results due to the apparent dependence of the emissivity of boron oxide on both temperature and wavelength. It was also found that care must be used to insure that the entire image is in sharp focus and that a means must be provided for measuring an accurate surface temperature. GRA

N93-17746# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
DIRECT NUMERICAL SIMULATION OF COMBUSTION IN TURBULENT SUPERSONIC FLOW [SIMULATION NUMERIQUE DIRECTE DE COMBUSTION EN ECOULEMENT SUPERSONIQUE TURBULENT]
R. J. Gathmann (Institut de Mecanique de Grenoble, France) and J. P. Chollet 1991 4 p In FRENCH Presented at 10th Congres Francais de Mecanique, Paris, France, 2-6 Sep. 1991
(DS-2138; ETN-93-93385) Avail: CASI HC A01/MF A01

The numerical code SERAC (French acronym for simulation of reactive flow for combustion applications) is presented. The turbulent combustion flow encompasses complex dynamic, thermodynamic and chemical kinetic interactions. The application of the code to simulate combustion in a confined mixing layer which represents the flow in a scramjet propulsion system is addressed. The code is also applied to simulate the three dimensional roundjet flow under periodic pressure also associated with supersonic aircraft propulsion. ESA

N93-17757# Department of Energy, Morgantown, WV. Energy Technology Center.
PULSE COMBUSTOR WITH CONTROLLABLE OSCILLATIONS Patent Application
George A. Richards, inventor (to DOE), Gary J. Morris Morris, inventor (to DOE), and Michael J. Welter, inventor (to DOE) 4 Mar. 1991 24 p
(DE93-002003; US-Patent-Appl-SN-663348; Patents-US-A-7663348) Avail: CASI HC A03/MF A01

A pulse combustor having thermally induced pulse combustion in a continuously flowing system is described. The pulse combustor is fitted with at lease one elongated ceramic body which significantly increases the heat transfer area in the combustion chamber of the combustor. The ceramic body or bodies possess sufficient mass and heat capacity to ignite the fuel-air charge once the ceramic body or bodies are heated by conventional spark plug initiated combustion so as to provide repetitive ignition and combustion of sequentially introduced fuel-air charges without the assistance of the spark plug and the rapid quenching of the flame after each ignition in a controlled manner so as to provide a selective control over the oscillation frequency and amplitude. Additional control over the heat transfer in the combustion chamber is provided by employing heat exchange mechanisms for selectively heating or cooling the elongated ceramic body or bodies and/or the walls of the combustion chamber. DOE

N93-17762# Pennsylvania State Univ., University Park.
FUNDAMENTAL STUDIES OF PASSIVITY AND PASSIVITY BREAKDOWN
D. D. Macdonald 20 Apr. 1992 31 p
(Contract DE-FG02-91ER-45461)
(DE93-002747; DOE/ER-45461/1) Avail: CASI HC A03/MF A01

Effects of minor alloying elements on passivity breakdown and of photo effects on the properties of passive films are under study, and electrochemical and photoelectrochemical techniques are being used to explore transport and kinetic properties of vacancies and charge carriers in films and at metal/film and film/solution interfaces. Point defect and solute/vacancy interaction models are being developed to account for distributions in critical voltage and induction time for passivity breakdown by incorporating thermodynamics of absorption of halide ions into surface oxygen vacancies, by invoking different mechanisms for cation vacancy generation at film/solution interface, by extending the models to passive films on metal substrates having variable cation oxidation states, and by deriving rate laws for growth of passive films in response to an imposed voltage perturbation. DOE

N93-17798# Politecnico di Milano (Italy). Dipartimento di Energetica.
INTERNATIONAL WORKSHOP ON MATHEMATICAL METHODS IN COMBUSTION Final Technical Report
Luigi DeLuca, Elaine S. Oran, M. Quinn. Brewster, Mikhail K. Strelets, and Boris V. Novozhilov May 1992 26 p Workshop held in Como, Italy, 18-22 May 1992
(AD-A258161) Avail: CASI HC A03/MF A01

The overall objective of the Workshop was to try to improve communications and promote cross-fertilizations between applied mathematicians and computational scientists, by pointing out promising directions as well as effective means of interaction. Specific objectives of the workshop were to critically compare analytic to numerical approaches, assess potentials and limitations of both, and hopefully foster new developments in combustion. To this end, a proper mix of formal lectures, specialized presentations, informal discussions, and constructive cross-criticism was implemented. GRA

N93-16891*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
VAPOR PHASE PYROLYSIS
Wolfgang Steurer *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 210-213 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

N93-17337*# Arkansas Univ., Fayetteville. Dept. of Mechanical Engineering.
COMPUTERIZED REDUCTION OF ELEMENTARY REACTION SETS FOR CFD COMBUSTION MODELING
Carl V. Wikstrom *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17614# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
EXPERIMENTAL ANALYSIS OF COMBUSTION OSCILLATIONS WITH REFERENCE TO RAMJET PROPULSION
M. N. R. Nina and G. P. A. Pita *In* AGARD, Airbreathing Propulsion for Missiles andProjectiles Sep. 1992 8 p (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A02/MF A03

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N93-15674# Argonne National Lab., IL.
CHEMICAL PROBES OF METAL CLUSTER STRUCTURE: Fe, Co, Ni, AND Cu
E. K. Parks, L. Zhu, J. Ho, and S. J. Riley 1992 14 p Presented at the 6th International Symposium on Small Particles and Inorganic Clusters, Chicago, IL, 16-22 Sep. 1992
(Contract W-31-109-eng-38)
(DE92-041109; ANL/CP-76413; CONF-920921-1) Avail: CASI HC A03/MF A01

Chemical reactivity is one of the few methods currently available for investigating the geometrical structure of isolated transition metal clusters. In this paper we summarize what is currently known about the structures of clusters of four transition metals, Fe, Co, Ni, and Cu, in the size range from 13 to 180 atoms. Chemical probes used to determine structural information include reactions with H2(D2), H2O, NH3 and N2. Measurements at both low coverage and at saturation are discussed. DOE

N93-15675# California Univ., Berkeley. Lawrence Berkeley Lab.
THE EFFECT OF LOW Au CONCENTRATIONS ON THE PROPERTIES OF EUTECTIC Sn/Pb Ph.D. Thesis
P. A. Kramer May 1992 81 p
(Contract DE-AC03-76SF-00098)
(DE92-041206; LBL-32390) Avail: CASI HC A05/MF A01

This study was of the effects moderately low Au concentrations (less than or = 10 wt percent) have on the mechanical properties and microstructure of an eutectic Sn/Pb alloy. Vibration (60-90 Hz swept sine wave for 30 hours) and thermal cycling (0-110 C for 1450 cycles) reliability tests were performed on fine pitch leaded chip carriers using eutectic Sn/Pb solder on PCB's (printed circuit boards) with 0, 5, 10, 20, and 50 (mu)in nominal Au thicknesses. Testing was also performed on double shear creep specimens consisting of arrays of regular pitch joints. There was a dramatic increase in the number of joints containing voids with increasing Au concentration, an effect more pronounced in the creep joints than in the reliability joints. These voids tended to coalesce and grow during rework simulation of the reliability joints. AuSn4 intermetallics present in the toe of 4.8 wt percent (50 (mu)in) Au vibration joints rotated from initial vertical perpendicular to surface of PCB metallization, solidification positions to roughly horizontal (parallel to plating surface) orientations during rework simulation and during aging of the parts. The AuSn4 intermetallics in the toe of the 4.8 wt percent (50(mu)in) Au reflowed joints also rotated after vibration testing. No joint failures were observed in either vibration tested or thermally cycled specimens. Cracks formed in some of the vibration tested specimen joints under the heel of the gull-wing lead at Pb-rich phases. Thermally cycled specimens showed eutectic microstructure and intermetallic coarsening without crack formation. Creep tests showed loss of the superplasticity in eutectic Sn/Pb alloys with even the lowest Au concentration tested of 0.2 wt percent Au. Intermetallic rotation was not a factor in crack propagation, but void presence was. Cracks tended to form in joints containing voids before forming in void-free joints. Crack propagation followed Sn/Sn grain boundaries and Sn/Pb phase boundaries from Pb-rich phase to Pb-rich phase. DOE

N93-15699# Virginia Univ., Charlottesville. Dept. of Materials Science and Engineering.
ENVIRONMENTALLY ASSISTED CRACKING OF HIGH STRENGTH BETA TITANIUM ALLOYS Annual Report, 15 Sep. 1991 - 15 Sep. 1992
J. R. Scully, R. P. Gangloff, L. M. Young, G. A. Young, Jr., and D. G. Kolman Oct. 1992 56 p
(Contract N00014-91-J-4164)
(AD-A256196; UVA/525464/MSE93/101) Avail: CASI HC A04/MF A01

The objective is to define the conditions under which high strength beta-titanium alloys are resistant to environmentally assisted cracking (EAC) in marine environments. Our goals are to: (1) characterize environment enhanced subcritical crack propagation behavior for metallurgical, chemical and mechanical loading conditions that could destabilize crack tip passive films to promote local dissolution and hydrogen uptake; (2) test the hydrogen embrittlement mechanism for EAC; and (3) develop a mechanism-based predictive model of EAC by integrating occluded crack chemistry, surface repassivation, hydrogen uptake and segregation at trap sites, and crack tip process zone micromechanics and damage. The behavior of two peak aged beta alloys, Beta 21S (Ti-15Mo-2.7Nb-3Al by wt pct and sigma sub ys = 1380 MPa) and Ti-15-3 (Ti-15V-3Cr-3Al-3Sn; sigma sub ys = 1315 MPa) plate, was emphasized. GRA

N93-15830*# Georgia Inst. of Tech., Atlanta. Mechanical Properties Research Lab.
DEFORMATION MECHANISMS OF NiAl CYCLICLY DEFORMED NEAR THE BRITTLE-TO-DUCTILE TRANSFORMATION TEMPERATURE Final Report
Stephen D. Antolovich, Ashok Saxena, and Cheryl Cullers 17 Dec. 1992 49 p
(Contract NCC3-116)
(NASA-CR-191649; NAS 1.26:191649) Avail: CASI HC A03/MF A01

One of the ongoing challenges of the aerospace industry is to develop more efficient turbine engines. Greater efficiency entails reduced specific strength and larger temperature gradients, the latter of which means higher operating temperatures and increased thermal conductivity. Continued development of nickel-based superalloys has provided steady increases in engine efficiency and the limits of superalloys have probably not been realized. However, other material systems are under intense investigation for possible use in high temperature engines. Ceramic, intermetallic, and various composite systems are being explored in an effort to exploit the much higher melting temperatures of these systems. NiAl is considered a potential alternative to conventional superalloys due to its excellent oxidation resistance, low density, and high melting temperature. The fact that NiAl is the most common coating for current superalloy turbine blades is a tribute to its oxidation resistance. Its density is one-third that of typical superalloys and in most temperature ranges its thermal conductivity is twice that of common superalloys. Despite these many advantages, NiAl requires more investigation before it is ready to be used in engines. Binary NiAl in general has poor high-temperature strength and low-temperature ductility. On-going research in alloy design continues to make improvements in the high-temperature strength of NiAl. The factors controlling low temperature ductility have been identified in the last few years. Small, but reproducible ductility can now be achieved at room temperature through careful control of chemical purity and processing. But the mechanisms controlling the transition from brittle to ductile behavior are not fully understood. Research in the area of fatigue deformation can aid the development of the NiAl system in two ways. Fatigue properties must be documented and optimized before NiAl can be applied to engineering systems. More importantly though, probing the deformation mechanisms operating in fatigue will lead to a better understanding of NiAl's unique characteristics. Low cycle fatigue properties have been reported on binary NiAl in the past year, yet those studies were limited to two temperature ranges: room temperature and near 1000 K. Eventually, fatigue property data will be needed for a wide range of temperatures and compositions. The intermediate temperature range near the brittle-to-ductile transition was chosen for this study to ascertain whether the sharp change occurring in monotonic behavior also occurs under cyclic conditions. An effort was made to characterize the dislocation structures which evolved during fatigue testing and comment on their role in the deformation process. Author

N93-15859# SRI International Corp., Menlo Park, CA.
EVALUATION OF A DIFFUSION/TRAPPING MODEL FOR HYDROGEN INGRESS IN HIGH-STRENGTH ALLOYS Annual Report, 15 Sep. 1991 - 15 Sep. 1992
Bruce G. Pound Oct. 1992 36 p
(Contract N00014-91-C-0263)
(AD-A257385) Avail: CASI HC A03/MF A01

Alloys developed to improve properties such as strength, weight, and corrosion resistance often show decreased resistance to hydrogen embrittlement. The objective was to determine the hydrogen ingress behavior of high performance alloys, particularly in terms of irreversible trapping, with a view to characterizing their interaction with hydrogen and resulting susceptibility to hydrogen embrittlement. A technique referred to as hydrogen ingress analysis by potentiostatic pulsing (HLAPP) was applied to three beta-titanium alloys (Beta-C, Ti10V-2Fe-3Al, and Ti-l3V-11Cr-3Al), an alpha titanium alloy (Ti-6Al-4V), and two copper-nickel alloys (Marinel and Monel K-500). Anodic current transients were obtained for these alloys in an acetate buffer (1 mol/L HAc-1 mol/L NaAc where Ac = acetate) and analyzed using a diffusion/trapping model under interface control conditions to evaluate the trapping constant and hydrogen entry flux. A marked increase observed in the trapping constants for the beta-titanium alloys with aging is attributed to precipitation of the secondary alpha phase. Aging also affects the passive film and therefore the hydrogen entry flux. The trapping constants for aged Marinel and Monel K-500 are not considered to differ significantly, but a smaller entry flux for the Marinel appears to account, at least partly, for the lower susceptibility to hydrogen embrittlement reported for Marinel. GRA

N93-15877# Naval Air Warfare Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.
MELT SPINNING OF INTERMETALLIC ALLOYS: HEAT TRANSFER AND MICROSTRUCTURE Final Report, Sep. 1991 - Apr. 1992
Jim S. Chen and William E. Frazier 21 Apr. 1992 37 p
(AD-A257455; NAWCADWAR-92029-60) Avail: CASI HC A03/MF A01

Analyses and experiments are performed to study heat transfer in melt spinning of intermetallic materials. Previous research efforts in the modeling, analysis, and measurement of melt spinning processes are reviewed. The importance is addressed of the process parameters including melt temperature, melt pouring rate, wheel temperature, spinning speed,

nozzle-to-wheel gap, and thermal properties of ribbon and wheel. A one-dimensional transient mathematical model is developed to predict thermal behavior of melt spinning. The solid-liquid interface velocity and the cooling rate for melt spun Al3Ti are presented. The significance of solidification rate is shown by comparing the macrostructure and microstructure of a rapidly solidified Al3Ti ribbon with a conventionally solidified ingot of the same composition. GRA

N93-15912# Purdue Univ., West Lafayette, IN. Dept. of Chemistry.
ELECTROSTATIC-FIELD EFFECTS ON ADSORBATE BONDING AND STRUCTURE AT METAL SURFACES: PARALLELS BETWEEN ELECTROCHEMICAL AND VACUUM SYSTEMS
Michael J. Weaver Oct. 1992 32 p
(Contract N00014-91-J-1409)
(AD-A256659; TR-133) Avail: CASI HC A03/MF A01

The observed effects of varying the surface potential, and hence the accompanying electrostatic fields, upon adsorbate bonding at ordered monocrystalline metals in electrochemical environments are summarized and discussed in comparison with field effects at related metal-vacuum interfaces for the specific case of carbon monoxide. The dependencies of the C-0 stretching frequency, nu(co), upon the electrochemical surface potential, E, (and interfacial field) as evaluated for CO adlayers at a fixed coverage, theta(co), and surface binding site are summarized as a function of theta(co) the metal substrate, and the double-layer ionic environment, in order to illustrate the virtues of electrochemical systems for exploring such interfacial field effects. The increasing preference for multifold versus terminal CO binding commonly observed towards lower potentials (and at larger negative fields) is also noted. These findings are compared with related field-induced effects observed for metal-CO adlayers in vacuum and also for chargeable metal-carbonyl clusters in solution. Variations in field for the former systems are induced by postdosing dipolar or ionizable coadsorbates, or by applying an external electrostatic field. Some physical differences as well as similarities in the electrostatic fields present for such systems are noted. The nu(co) dependencies observed for the different systems are compared briefly with the predictions of theoretical models which account for potential-dependent surface-adsorbate bonding and interfacial field-induced Stark effects. GRA

N93-15927# Delaware Univ., Newark.
CHEMISTRY OF OXYGENATES ON TRANSITION METAL SURFACES: ACTIVATION OF C-H, C-C, AND C-O BONDS
1991 4 p
(Contract DE-FG02-84ER-13290)
(DE92-040843; DOE/ER-13290/8) Avail: CASI HC A01/MF A01

The goal is to understand the requirements for and competition between activation of C-H, C-C, and C-O bonds in the synthesis and decomposition of oxygenates on transition metal surfaces. Efforts during the past year was devoted primarily to the role of activation of beta-CH bonds in decarbonylation of higher oxygenates on surfaces of metals such as Rh and Pd; studies were completed of more than a dozen C(1) to C(3) oxygenates on Rh(111), and progress was made with reagents for which beta-CH scission is blocked. It is shown that alcohols and aldehydes do not react via a common pathway on Rh(111). Ethanol and acetaldehyde are formed from CO + H2 by parallel routes on Rh catalysts which do not contain interacting supports or oxide promoters; i.e., the two compounds result from CO insertion into different metal-hydrocarbon bonds. Aldehydes decarbonylate via alpha-CH scission to form acyl, followed by C-C scission to release an alkyl ligand; this ligand undergoes hydrogenation and dehydrogenation steps. Alcohols form surface alkoxides, but these do not dehydrogenate further to the aldehydes, they release CO + H2 but no volatile hydrocarbon. These results indicate that beta-CH scissors to form a surface oxametallacycle intermediate; supporting evidence is presented for this intermediate. Chemistry of alcohols blocked to different extends at the beta-position was also studied; complete blocking (CF3CH2OH) forces the reaction to follow the aldehyde-acyl path, while partial substitution at the 'beta' position (branched alcohols) favors the oxametallacycle pathway. DOE

N93-15937# Los Alamos National Lab., NM.
CRYSTALLOGRAPHIC TEXTURE EFFECTS IN HYDROFORMING OF ALUMINUM SHEET
P. R. Dawson (Cornell Univ., Ithaca, NY.), A. J. Beaudoin (Cornell Univ., Ithaca, NY.), K. K. Mathur (Thinking Machines Corp., Cambridge, MA.), U. F. Kocks, and D. A. Korzekwa 1992 10 p Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers, Anaheim, CA, 8-13 Nov. 1992
(Contract W-7405-eng-36)
(DE92-040368; LA-UR-92-2830; CONF-921110-27) Avail: CASI HC A02/MF A01

The success of hydroforming operations, as well as many other sheet forming processes, depends strongly on the initial condition of the stock material. The stock material may be in a variety of states as a consequence of its processing history. The crystallographic texture may range from a pronounced deformation texture imparted by rolling operations to a cube texture that could arise from recrystallization. Such variations in the texture impose significant differences on the plastic response of the material. To accurately predict the deformations during hydroforming, the effects of the crystallographic texture on the anisotropy of the plasticity must be included in the forming model. In this paper, polycrystalline plasticity is used in conjunction with a three dimensional, transient, finite element formulation to simulate hydroforming. The procedure to initialize the starting state of the material in terms of aggregates of crystals is emphasized as it is an essential element in treating work hardened materials. Massively parallel algorithms are employed to interrogate aggregates for the purpose of evaluating mechanical properties and to update their states. Application to drawing of aluminum sheet using the hydroform process demonstrates the ability of the formulation to capture effects such as earing. DOE

N93-15950# Oak Ridge National Lab., TN.
GRAIN COMPETITION IN BICRYSTAL WELDS
J. M. Vitek, S. A. David, L. A. Boatner, and M. Rappaz (Ecole Polytechnique Federale, Zurich, Switzerland) 1992 7 p Presented at the 3rd International Conference on Trends in Welding Research, Gatlinburg, TN, 1-5 Jun. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040707; CONF-9206173-9) Avail: CASI HC A02/MF A01

The dendritic solidification microstructure of electron beam (EB) welds made along the boundary between two oriented, single crystals of an Fe-15 wt percent Ni-15 wt percent Cr alloy were examined. The dendritic solidification patterns, as viewed in transverse optical micrographs, were explained in terms of a previously developed geometric model in which growth selection among the possible dendritic growth directions was determined by a minimum-growth-velocity or, equivalently, a minimum-undercooling criterion. Two different combinations of preselected crystal orientations were evaluated for signs of growth competition between the dendrites in the two bicrystals. It was found that almost the entire dendritic microstructure could be predicted by simply combining the dendritic growth patterns that are expected in the corresponding halves of identically oriented single-crystal welds. However, evidence for the growth of one crystal into the other at the bicrystal-weld junction was found. This tendency, and its extent, could be explained by the same minimum-growth-velocity criterion that was used for the single-crystal welds when this criterion was extended to comparing the dendritic growth directions between the two differently oriented crystals. DOE

N93-15951# Oak Ridge National Lab., TN.
LATTICE DAMAGE IN ION-IMPLANTED SILICON-GERMANIUM ALLOYS
T. E. Haynes and O. W. Holland Aug. 1992 15 p Presented at the 8th International Conference on Ion Beam Modification of Materials, Heidelberg, Germany, 7-11 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040860; CONF-9209200-1) Avail: CASI HC A03/MF A01

The damage produced in Si(1-x)Ge(x) alloys (0 less than or = x less than or = 1) by implantation of 70-100 keV Si(+)-30 has been measured as a function of temperature and fluence by ion channeling. For all compositions, the damage efficiency decreased sharply as the implant temperature was increased between room temperature and 150 C. Furthermore, the damage efficiency in alloys of intermediate compositions (0.34 less than or = x less than or = 0.5) exceeds that in Ge, especially at elevated temperatures, despite the larger cascade energy density in Ge. It is shown that this behavior can be described based on a model in which the point-defect mobility is the dominant factor controlling damage retention, rather than the cascade energy density. This approach provides

a framework for understanding other temperature-dependent phenomena related to damage growth in Si-Ge alloys including dose-rate effects and damage saturation in MeV implantation. DOE

N93-15967# California Univ., Berkeley. Lawrence Berkeley Lab.
NUCLEATION AND GROWTH IN ELECTRODEPOSITION OF THIN COPPER FILMS ON PYROLYTIC GRAPHITE Ph.D. Thesis
F. S. Kinaci and R. H. Muller May 1992 152 p
(Contract DE-AC03-76SF-00098)
(DE92-041216; LBL-32400) Avail: CASI HC A08/MF A02

Electrodeposition of Cu on graphite electrodes was studied, with emphasis on nucleation. Various ex-situ and in-situ methods were investigated for determining the number density of nuclei. Two direct methods were studied (scanning electron microscopy and scanning tunneling microscopy); indirect determinations included Raman spectroscopy and analysis of potentiostatic current transients. Though some of the techniques correctly predicted the nucleation densities under special conditions, SEM was the most reliable tool. The large scatter in the data necessitated steps to minimize this effect. To electrodeposit Cu on graphite, a nucleation overpotential of 250 mV was measured with cyclic voltammetry; such a large overpotential does not occur on a Pt or on a Cu-covered graphite electrode. The deposition potential is the dominant parameter governing nucleation density. There is a sharp increase in the nucleation density with applied potential. Cu can be deposited on highly oriented pyrolytic graphite only between the nucleation overpotential and the hydrogen evolution potential. To increase the Cu nucleation density, while avoiding excessive H evolution, a double pulse potential technique was used; nucleation densities on the order of 10(exp 10) nuclei/sq cm were achieved. The use of inhibitors (PVA, benzotriazole) was also investigated. Deposition on conducting polymer electrodes was also studied; initial results with polyaniline show promise. DOE

N93-15982# Naval Postgraduate School, Monterey, CA.
THE ROLE OF PARTICLES IN RECRYSTALLIZATION OF A THERMOMECHANICALLY PROCESSED Al-Mg ALLOY M.S. Thesis
Stephen A. Rogers Sep. 1992 65 p
(AD-A257315) Avail: CASI HC A04/MF A01

The microstructural evolution related to the superplastic response of an Al-10Mg-0.1Zr alloy during thermomechanical processing (TMP) was studied. The TMP had been accomplished in previous work and consisted of 12 rolling passes, with reheating between each pass, to a total strain of 2.5. Quantitative data including length, aspect ratio and area of precipitated B-phase (Al8Mg5) particles were obtained using image analysis methods applied to the as-rolled conditions following passes 8, 10 and 12. The corresponding accumulated strains were 1.5, 2.0 and 2.6, respectively. Precipitation of the Beta-phase is complete by pass 8 and the size as well as the size distribution remained essentially unchanged in the subsequent passes. A model for particle-stimulated nucleation of recrystallization, which is based on thermodynamic considerations, is evaluated with respect to experimental data. GRA

N93-16019# Delaware Univ., Newark.
NOVEL WAYS OF DEPOSITING ZnTe FILMS BY A SOLUTION GROWTH TECHNIQUE
R. W. Birkmire, B. E. McCandless, T. A. Yokimcus, and A. Mondal Oct. 1992 79 p Prepared for Midwest Research Inst., Golden, CO
(Contract DE-AC02-83CH-10093)
(DE92-010591; NREL/TP-410-4959) Avail: CASI HC A05/MF A01

An electrochemical process has been successfully developed for the reproducible deposition of ZnTe and copper-doped ZnTe films suitable as transparent ohmic contacts for CdS/CdTe solar cells. The development of this method and optimization of key processing steps in the fabrication of CdS/CdTe/ZnTe:Cu devices has allowed IEC to achieve cell performance results of FF greater than 70 percent and eta approximately 10 percent. Preliminary efforts have indicated that the deposition methods investigated are potentially feasible for the formation of other II-VI compounds for use in polycrystalline thin film solar devices and should be the focus of future work. DOE

N93-16114# Naval Postgraduate School, Monterey, CA.
REAL-TIME DETECTION OF FATIGUE CRACKS AT MULTIPLE HOLES IN 7075 ALUMINUM USING ACOUSTIC EMISSION M.S. Thesis
Thomas Flatley Sep. 1992 76 p
(AD-A257102) Avail: CASI HC A05/MF A01

In the E-2C Hawkeye's wing center section, stress fractures have been identified in the main beam web section. The cracks occurred in several web section attachment holes. Previous work, concerned with fatigue data, used a finite element code to design a specimen which modeled the actual section of the beam at one particular fastener hole near wing station 49. Acoustic emission testing was used to determine if crack initiation could be identified. In this work, acoustic emission techniques were applied to the monitoring of multiple cracks. The E-2C fatigue spectrum was used to load the specimens but fatigue testing was not an objective. Specimens were modified by drilling holes and attaching angles that represented the structural shapes used to attach the section to the wing skin. The original one-hole configuration and the new multiple hole specimen configuration were tested. The cap angles were found to create a great deal of noise containing frequency components below 400 kHz. Special high pass filters were fabricated which eliminated most of this noise. It was shown that linear location could be used to discriminate between crack growth signals and the filtered noise signals. GRA

N93-16122# Naval Academy, Annapolis, MD.
THE INFLUENCE OF HEAT TREATMENT ON THE PERFORMANCE OF HIGHLY CORROSION RESISTANT ALUMINUM ALLOYS Final Report, 1991 - 1992
Frederick G. Schenk 8 May 1992 84 p
(AD-A257115; USNA-TSPR-197) Avail: CASI HC A05/MF A01

New 'stainless aluminum' alloys must be produced using expensive processing methods such as co-sputter deposition and ion implantation. To determine the influence of temperature on the sputter deposited alloys heat treatments were conducted. These heat treatments caused pitting potential to decrease from the 'as processed' values, but did not cause a total loss of corrosion properties relative to pure aluminum. Constant potential tests below the determined pitting potential were conducted on both heat treated and 'as processed' sputter deposited alloys in an attempt to confirm the heat treatment data. Anodic currents were observed for both conditions. Some mechanical failure has been noted with these thin film alloys, which could result in crevice corrosion, possibly causing the anodic currents detected. This contradictory result requires further investigation. GRA

N93-16148# University of Southern California, Los Angeles. Dept. of Materials Science and Engineering.
DEFORMATION TWINNING IN ORDERED ALLOYS TRANSFORMATION INDUCED DUCTILITY IN INTERMETALLICS
E. Goo Sep. 1992 5 p
(Contract DE-FG03-88ER-45346)
(DE93-002879; DOE/ER-45346/T1) Avail: CASI HC A01/MF A01

Intermetallics, which are ordered alloys, have excellent high temperature strength. Unfortunately a universal problem facing intermetallics is the lack of ductility. This program attempted to look at some novel solutions for enhancing ductility in intermetallics. Deformation twinning has been demonstrated in TiNi to be responsible for its ductility. This was a surprising result since twinning was not believed to occur readily in ordered alloys. Furthermore the twinning occurred on a (114) plane which had not been previously observed. Research into determining the mechanisms for twinning in ordered alloy and understanding how twinning enhances the ductility of intermetallic was studied. Martensitic transformations in many intermetallics also provides a possible means of enhancing ductility. The detwinning of martensite twins or transformation induced martensite provides a mechanism for accommodating large strains. It is known that a metastable martensitic phase may be created by quenching a non-stoichiometric NiAl alloy. This presents the potential of substantial ductility in NiAl. Study of the martensitic phase transformation and its effects on the ductility of NiAl alloys was examined. DOE

N93-16149# California Univ., Berkeley. Lawrence Berkeley Lab.
THE INFLUENCE OF DEFORMATION-INDUCED MARTENSITE ON THE CRYOGENIC BEHAVIOR OF 300-SERIES STAINLESS STEELS
J. W. Morris, Jr., J. W. Chan, and Z. Mei Jun. 1992 14 p Presented at the International Cryogenic Engineering Conference and the International Cryogenic Materials Conference, Kiev (Ukraine), 8-12 Jun. 1992

(Contract DE-AC03-76SF-00098)
(DE92-041208; LBL-32095; CONF-920614-4) Avail: CASI HC A03/MF A01

The 300-series stainless steels that are commonly specified for the structures of high field superconducting magnets are metastable austenitic alloys that undergo martensitic transformations when deformed at low temperature. The martensitic tranformation is promoted by plastic deformation and by exposure to high magnetic fields. The transformation significantly influences the mechanical properties of the alloy. The mechanisms of this influence are reviewed, with emphasis on fatigue crack growth effects and magnetomechanical phenomena that have only recently been recognized. DOE

N93-16197# Oak Ridge National Lab., TN.
COLLOIDAL Au AND Ag PRECIPITATES FORMED IN Al2O3 BY ION IMPLANTATION AND ANNEALING
C. W. White, D. K. Thomas, D. K. Hensley, R. A. Zuhr, J. C. McCallum (Royal Melbourne Inst. of Tech., Australia), A. Pogany (Royal Melbourne Inst. of Tech., Australia), and R. F. Haglund (Vanderbilt Univ., Nashville, TN.) Sep. 1992 10 p Presented at the Conference on Nanostructured Materials, Cancun, Mexico, 21-25 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE93-000969; CONF-920947-1) Avail: CASI HC A02/MF A01

Ion implantation and thermal annealing have been used to create localized regions containing a high density of colloidal Au or Ag precipitates in Al2O3. These colloidal precipitates give rise to dramatic optical absorption effects through surface plasmon resonance absorption. DOE

N93-16203# Oak Ridge National Lab., TN.
PHASE BEHAVIOR OF Au AND Pt SURFACES
G. Gruebel (European Synchrotron Radiation Facility, Grenoble, France), D. Gibbs (Brookhaven National Lab., Upton, NY.), D. M. Zehner, D. L. Abernathy (Risoe National Lab., Roskilde, Denmark), and S. G. G. Mochrie (Massachusetts Inst. of Tech., Cambridge.) 1992 11 p Presented at the 12th International Vacuum Congress; 8th International Conference on Solid Surfaces, Hague, Netherlands, 12-16 Oct. 1992
(Contracts DE-AC05-84OR-21400; DE-AC02-76CH-00016)
(DE92-041021; CONF-9210161-2; CONF-9210162-2) Avail: CASI HC A03/MF A01

We summarize the results of x-ray scattering studies of the Au(001) and Pt(001) surfaces between 300 K and their respective bulk melting temperatures (T(sub m)). Both surfaces exhibit three distinct structural phases. At high temperatures (0-88 T(sub m) less than T less than T(sub m)) both surfaces are disordered. At a temperature of T/T(sub m) - 0.88 there are reversible phase transformations to incommensurate, corrugated-hexagonal phases. Below T/T(sub m) - 0.8 hexagonal domains rotate with respect to the substrate orientation. In Pt, the rotational transformation is continuous and shows mean-field behavior. In Au, the rotational transformation is mainly discontinuous. DOE

N93-16234# Colorado School of Mines, Golden. Center for Welding and Joining Research.
THE PYRO-METALLURGICAL, PHYSICAL, AND MECHANICAL BEHAVIOR OF WELDMENTS Final Report
R. H. Frost and D. L. Olson Aug. 1992 22 p
(Contract DAAL03-89-K-0091)
(AD-A256998; MT-CWR-092-034; ARO-26728.19-MS) Avail: CASI HC A03/MF A01

The physical and chemical behavior of welding consumables were investigated in studies of the titanium and zirconium as grain refining nucleants in aluminum alloys, and studies of the influence of titanium, zirconium and boron additions on oxide inclusion formation and on the nucleation of acicular ferrite in microalloyed steel weld metal. The influence of electrochemical reactions during arc welding on weld metal composition was investigated for direct current welding processes including: covered electrode welding gas-metal-arc welding and gas-tungsten-arc welding. The influence of cover gas composition on the weld metal microstructural formation in gas-metal-arc welds was studied. Also the influence of underwater wet conditions on the weld metal metallurgy and the management of hydrogen in steel including its influence on weld pore formation were studied. GRA

N93-16279# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
MULTIPLE-SITE-DAMAGE IN 2024-T3 ALLOY SHEET
O. Partl and J. Schijve Jan. 1992 43 p
(LR-660; ETN-92-92865) Avail: CASI HC A03/MF A01

A simple computational procedure, using the principles of fracture mechanics and a compounding K solution method, was developed for predicting fatigue crack growth if Multiple Site Damage (MSD) is present. The prediction method was verified using results of a series of fatigue crack growth tests performed in 2024 T3 alloy sheet specimens with a colinear row of open holes and artificially introduced flaws at the three central holes. Three different geometrical configurations were adopted. A good agreement was found between the test results and the predictions. An obvious crack interaction effect was found, but it mainly occurred in the last part of the fatigue crack growth lives. The relative size of MSD cracks is significantly dependent on scatter of the size of the initial crack nuclei. ESA

N93-16299# Army Lab. Command, Watertown, MA. Material Technology Lab.
THE TITANIUM-ALUMINUM PHASE DIAGRAM: A REVIEW OF THE NEAR Ti-50 AT. PCT. Al PHASE FIELDS Final Report
Ernest S. Chin and Ronald R. Biederman Jul. 1992 26 p
(AD-A255685; MTL-TR-92-47) Avail: CASI HC A03/MF A01

The understanding of the titanium-aluminum (Ti-Al) phase diagram is of great importance to the development of titanium-aluminide alloys and composites for high temperature applications. The Ti-Al phase diagram near 50 atomic percent (at.pct.) aluminum is critically reviewed. Murray's Ti-Al phase diagram has been well accepted by the materials community in the late 1980s. Recent results from solidification experiments point toward the existence of a high temperature alpha phase field consistent with two high temperature peritectic reactions (beta + L - alpha + L -* gamma) near 50 at.pct. aluminum. These reactions are not accounted for in Murray's Ti-Al phase diagram. Close evaluation of the past experimental techniques by which data were utilized in Murray's calculation of the Ti-Al phase diagram revealed areas of uncertainties. These uncertainties are primarily due to the limitation of analytical capabilities available at the time the experiments were performed. GRA

N93-16334# Los Alamos National Lab., NM.
THE ELECTRONIC STRUCTURE OF CORE STATES UNDER EXTREME COMPRESSIONS
Galen K. Straub 1992 10 p Presented at the 23rd Summer School on Theoretical Physics Moscow Engineering Physics Inst., Tveroblast, Russia, 1-5 Jun. 1992
(Contract W-7405-eng-36)
(DE92-017451; LA-UR-92-1993; CONF-9206252-1) Avail: CASI HC A02/MF A01

At normal density and for modest compressions, the electronic structure of a metal can be accurately described by treating the conduction electrons and their interactions with the usual methods of band theory. The core electrons remain essentially the same as for an isolated free atom and do not participate in the bonding forces responsible for creating a condensed phase. As the density increases, the core electrons begin to 'see' one another as the overlap of the tails of wave functions can no longer be neglected. The electronic structure of the core electrons is responsible for an effective repulsive interaction that eventually becomes free-electron-like at very high compressions. The electronic structure of the interacting core electrons may be treated in a simple manner using the Atomic Surface Method (ASM). The ASM is a first-principles treatment of the electronic structure involving a rigorous integration of the Schroedinger equation within the atomic-sphere approximation. Solid phase wave functions are constructed from isolated atom wave functions and the band width W(sub l) and the center of gravity of the band C(sub l) are obtained from simple formulas. The ASM can also utilize analytic forms of the atomic wave functions and thus provide direct functional dependence of various aspects of the electronic structure. Of particular use in understanding the behavior of the core electrons, the ASM provides the ability to analytically determine the density dependence of the band widths and positions. The process whereby core states interact with one another is best viewed as the formation of narrow electron bands formed from atomic states. As the core-core overlap increases, the bands increase in width and mean energy. In Sec. 3 this

picture is further developed and from the ASM one obtains the analytic dependence on density of the relative motion of the different bands. Also in Sec. 3 is a discussion of the transition to free electron bands. DOE

N93-16450# Oak Ridge National Lab., TN.
THE DIRECT MONTE CARLO METHOD FOR CALCULATING ALLOY PHASES
J. S. Faulkner (Florida Atlantic Univ., Boca Raton.), E. A. Horvath (Florida Atlantic Univ., Boca Raton.), Yang Wang (Florida Atlantic Univ., Boca Raton.), and G. M. Stocks 1992 7 p Presented at the NATO Advanced Study Institute on Statics and Dynamics of Alloy Phase Transformations, Rhodes, Greece, 21 Jun. - 3 Jul. 1992
(Contracts DE-AC05-84OR-21400; DE-FG05-89ER-45392)
(DE93-000436; CONF-9206202-2) Avail: CASI HC A02/MF A01

Theories exist for predicting the structure of an alloy on the assumption that the energy of the alloy can be obtained from an Ising model Hamiltonian. It is not necessary to introduce interatomic potentials if the Monte Carlo method is used for thermodynamics. (Delta)H is calculated directly from the electronic structure of the alloy using the embedded cluster method (ECM) of alloy theory. ECM is based on the coherent potential approximation (CPA) for the electronic states of random substitutional alloys. A version of the theory was developed within the context of the tight-binding model. Cray ymp calculations were made for a 50/50 Pd/Rh fcc alloy; electronic energies were obtained using an ECM based on KKR-CPA programs. The top of the miscibility gap is predicted to be at 1415 K. The order parameter vs T graph shows a critical temperature just above 1200 K. Calculations in the grand canonical mode are underway. The calculations are for the fcc lattice, but the bcc lattice is also considered. There are other methods, such as the Harris approximation, that will improve the energy calculations. DOE

N93-16488# Technische Univ., Delft (Netherlands).
DIFFUSION BONDING OF SILICON NITRIDE TO AUSTENITIC STAINLESS STEEL Ph.D. Thesis
Bernardus Theodorus Stoop 1991 172 p
(ETN-92-92789) Avail: CASI HC A08/MF A02

A study to obtain insight into the possibility of joining silicon nitride to austenitic stainless steel using the diffusion bonding process is presented. The theoretical background of ceramic metal diffusion bonding is given. Models describing various aspects of ceramic metal diffusion bonding are discussed. Information about thermodynamics of the systems studied is given as well as data on the kinetics of mass transport. Principles of mechanical testing of ceramic metal joints are addressed. Materials and equipment used are described. Diffusion bonding of hot pressed silicon nitride to austenitic stainless steel without the use of interlayers is discussed. Diffusion bonding of hot pressed silicon nitride to austenitic stainless steel with Fe, Ni, INVAR, or KOVAR interlayers is then discussed. The following are also considered: determination of optimum bonding conditions, investigation of the joint microstructure, evaluation of its mechanical properties, and the relation between joint microstructure and the mechanical strength of the joints. The influence of joint geometry and interlayer type on the residual stress level was established using finite element method calculations. ESA

N93-16509 Northwestern Univ., Evanston, IL.
MULTIAXIAL FATIGUE ANALYSIS OF METALS Ph.D. Thesis
Wei-Ren Chen 1992 132 p
Avail: Univ. Microfilms Order No. DA9229890

This dissertation has focussed on the theoretical analyses for the characterization of metals under multiaxial fatigue loading. The analyses concentrate on developing the mixed-mode fatigue crack growth equations for predicting analytically the crack growth rate of materials in mixed mode loadings, and on constructing a reasonable theoretical multiaxial fatigue life prediction methodology for materials from uniaxial fatigue test data and stress-strain results based on the cyclic plasticity theory. The ultimate objective is to gain a better understanding of the appropriate characterization of materials and development of better multiaxial fatigue theories under multiaxial loading conditions. Based on the mixed mode Dugdale model of a slit-like crack, the accumulated plastic displacement criterion for crack propagation and the cyclic J-integral concept, a fourth-power stress intensity factor crack growth equation and a second-power cyclic J-integral equation are developed under conditions of mixed mode loading and small-scale yielding. A semi-empirical mixed mode fatigue crack growth prediction methodology was developed by using the uniaxial fatigue crack growth test results. By comparing the present analysis of the fatigue crack growth with the experimental data, the proposed formula appear to yield reasonable results for various loading conditions. A mixed mode fatigue crack growth of a penny-shaped crack under combined tensile and shear loadings is also analyzed. Based on the mixed mode penny-shaped Dugdale crack model, and the accumulated plastic displacement criterion for crack growth, a Paris-type fatigue crack growth equation with fourth-power effective stress intensity factor dependence is developed under conditions of multiaxial loading and small-scale yielding. A cyclic plasticity model is proposed for analyzing the stress-strain relationship of materials under multiaxial fatigue loading based on the Mises yield condition, associated flow rule and nonlinear kinematic hardening rule. A theoretical multiaxial fatigue life prediction methodology is developed for materials on the basis of the uniaxial fatigue test data on smooth specimens and stress-strain results obtained from the cyclic plasticity theory. It is shown that a reasonable description of steady-state hysteresis stress-strain loops and prediction of fatigue lives under various combined axial-torsional loadings are given by this model. Dissert. Abstr.

N93-16580# Technische Univ., Delft (Netherlands).
PASSIVITY AND STRESS CORROSION CRACKING OF AISI 316 STAINLESS STEEL IN CHLORIDE-CONTAINING SOLUTIONS Ph.D. Thesis
Ahmad Dawud Ahmad Harbiye 1991 128 p
(ETN-92-92783) Avail: CASI HC A07/MF A02

Stress Corrosion Cracking (SCC) behavior of solution annealed and quenched AISI 316 stainless steel in chloride containing solutions at temperatures ranging from 150 to 250 C was studied. Stainless steel obtains its relatively good resistance against corrosion by a protective film (passivity) which also exists at these temperatures over strain potential ranges. Thus, the relation between the stress corrosion cracking behavior and the passivation behavior of AISI 316 was the principal focus. A literature survey was performed. An overview of models for SCC, and the experimental procedures, are given. The effect of cooling the sample from the test temperature to room temperature on the properties of the passive films formed on these samples, is discussed. The results of the study of the passivation behavior of AISI 316 are given. The critical potential for SCC was studied in greater detail. The effect of the environment on the critical potential in relation to passivity is given. The effects of chloride and oxygen at constant temperature is considered, together with the effect of temperature and oxygen at constant chloride concentration. ESA

N93-16637 ESDU International Ltd., London (England).
FATIGUE PROPAGATION BEHAVIOUR OF SHORT CRACKS IN TITANIUM ALLOYS Abstract Only
Nov. 1992 30 p
(ESDU-92023; ISBN-0-85679-828-2) Avail: ESDU

ESDU 92023 discusses the different propagation behavior of short and long cracks; short cracks often do not display a threshold value of stress intensity factor range and propagate at higher rates than long cracks. The difficulties of calculating the stress intensity factor for short cracks are explained. Experimental data extracted from the literature for crack growth rate in air under constant amplitude loading are presented graphically against stress intensity factor range for 7 alloys (IMI 318, IMI 685, Ti-4Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-8Al, Ti-8.6Al). All the curves are derived from a number of tests except that some data for IMI 318 and Ti-8.6Al relate to individual cracks. Details of the alloy, heat treatment and mechanical properties are included, and the experimental arrangement for each set of data is indicated. For IMI 318, IMI 685 and Ti-6Al-4V, data for short and long crack growth are compared. The effect of stress ratio is shown for Ti-8Al (values of 0.1 and 0.5) and for Ti-6Al-4V (values of 0 and -1). Author

N93-16641 ESDU International Ltd., London (England).
FATIGUE PROPAGATION BEHAVIOUR OF SHORT CRACKS IN ALUMINUM ALLOYS Abstract Only
Nov. 1992 34 p
(ESDU-92030; ISBN-0-85679-836-3) Avail: ESDU

ESDU 92030 discusses the different propagation behavior of short and long cracks; short cracks often do not display a threshold value of stress

intensity factor range and propagate at higher rates than long cracks. The difficulties of calculating the stress intensity factor for short cracks are explained. Experimental data extracted from the literature for crack growth rate in air under constant amplitude loading are presented graphically against stress intensity factor range for 9 alloys (2024, 2090, 2124, 7010, 7075, 8090, 8091, RR58, an Al-Li alloy) and in vacuum and nitrogen for 7075. All the curves are derived from a number of tests except for 2124 for which data are for individual cracks. Details of the alloy, heat treatment and mechanical properties are given, and the experimental arrangement for each set of data is indicated. For all alloys, except 7010 and 7075, data for both short and long crack growth are compared, and for 2090 the effect of stress ratio variation from 0 to -2 is shown. Author

N93-16649# Japan Automobile Research Inst., Tokyo.
CREEP RUPTURE PROPERTIES OF A NICKEL-BASE HEAT-RESISTANT ALLOY HASTELLOY XR UNDER VARYING STRESS CONDITION
Hirokazu Tsuji, Hajime Nakajima, Tatsuhiko Tanabe, and Yuji Nakasone May 1992 24 p
(DE92-556729; JAERI-M-92-074) Avail: CASI HC A03/MF A01

A series of constant load and temperature creep rupture tests and varying stress creep rupture tests was carried out on a nickel-base heat-resistant alloy Hastelloy XR, which was developed for applications in the High-Temperature Engineering Test Reactor, at temperatures ranging from 850 to 1000 C in order to examine the applicability of the conventional creep damage rules, i.e., the life fraction, the strain fraction and their mixed rules. Among these three criteria, the life fraction rule showed the best applicability. The good applicability of the rule was considered to result from the fact that the creep strength of Hastelloy XR was not strongly affected by the change of the chemical composition and/or the microstructure during exposure to the high-temperature simulated HTGR helium environment. In conclusion the life fraction rule is applicable in engineering design of high-temperature components made of Hastelloy XR. DOE

N93-16701*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE EFFECT OF TENSILE STRESS ON HYDROGEN DIFFUSION IN METAL ALLOYS
M. D. Danford Dec. 1992 43 p
(NASA-TM-108386; NAS 1.15:108386) Avail: CASI HC A03/MF A01

The effect of tensile stress on hydrogen diffusion has been determined for Type 303 stainless steel, A286 CRES, and Waspaloy and IN100 nickel-base alloys. It was found that hydrogen diffusion coefficients are not significantly affected by stress, while the hydrogen permeabilities are greatly affected in Type 303 stainless steel and A286 CRES (iron-based alloys), but are affected little in Waspaloy (nickel-base) and not affected in all in IN100 (nickel base). These observations might be taken as an indication that hydrogen permeabilities are affected by stress in iron-based alloys, but only slightly affected in nickel-based alloys. However, it is too early to make such a generalization based on the study of only these four alloys. Author

N93-16711*# Alabama Univ., Huntsville. Materials Processing Lab.
STUDY OF FES/CAST/HGS Final Report
Gary L. Workman, Rick Cummings, and Brian Jones 20 Oct. 1992 19 p
(Contract NAS8-38609)
(NASA-CR-190945; NAS 1.26:190945) Avail: CASI HC A03/MF A01

The microgravity materials processing program has been instrumental in providing the crystal growth community with an experimental environment to better understand the phenomena associated with the growing of crystals. In many applications one may pursue the growth of large single crystals which cannot be grown on earth due to convective driven flows. A microgravity environment is characterized by neither convection of buoyancy. Consequently superior crystals are able to be grown in space. On the other hand, since neither convection nor buoyancy dominates the fluid flow in a microgravity environment, then lesser dominating phenomena can affect crystal growth, such as surface driven flows or diffusion limited solidification. In the case of experiments that are to be flown in space using the Fluid Experiments System (FES), diffusion limited growth should be the dominating phenomenon. The use of holographic and Schlieren optical techniques for studying the concentration gradients in solidification processes has been used by several investigators over the years. The Holographic Ground System (HGS) facility at MSFC has been a primary resource in researching this capability. Consequently scientific personnel have been able to utilize these techniques in both ground based research and in space experiments. An important event in the scientific utilization of the HGS facilities was the TGS (triglycine sulfate) Crystal Growth and the Casting and Solidification Technology (CAST) experiments that were flown on the International Microgravity Lab (IML) mission in March of this year. The preparation and processing of these space observations are the primary experiments reported in this work. This project provides some ground-based studies to optimize on the holographic techniques used to acquire information about the crystal growth processes flown on IML. Since the ground-based studies will be compared with the space-based experimental results, it is necessary to conduct sufficient ground based studies to best determine how the experiment in space worked. The current capabilities in computer based systems for image processing and numerical computation have certainly assisted in those efforts. As anticipated, this study has certainly shown that these advanced computing capabilities are helpful in the data analysis of such experiments. Author

N93-16927# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.
THE ROLE OF GRAIN BOUNDARY CHEMISTRY AND STRUCTURE IN THE ENVIRONMENTALLY-ASSISTED INTERGRANULAR CRACKING OF NICKEL-BASE ALLOYS
G. S. Was Jul. 1992 32 p
(Contract DE-FG02-85ER-45184)
(DE93-003126; DOE/ER-45184/T1) Avail: CASI HC A03/MF A01

Stress corrosion cracking tests in constant extension rate tensile (CERT) and constant load tensile (CLT) tests were conducted on Ni-xCr- 9Fe-yC in Ar, water, and a LiOH-boric acid solution. Cr and C improve the resistance of Ni-base alloys to IG cracking in both Ar and water at 360C. Since creep plays a role in IG cracking, one possible explanation for the role of the environment involves its effect on the creep. Experiments were conducted on the role of C in the deformation behavior and failure mode of Ni-16Cr-9Fe. Constant load experiments were conducted on Ni-16Cr-9Fe to determine if the CLT test is more aggressive than CERT. The electron backscattering technique in a SEM is being developed in order to extend the IG cracking studies to grain sizes typical of commercial alloys, 20-30 microns. DOE

N93-16971# Argonne National Lab., IL.
ORIENTATIONAL PHASE TRANSITIONS IN ALLOYS
M. L. Saboungi, G. K. Johnson, and D. L. Price 22 Sep. 1992 7 p Presented at the NATO Advanced Study Inst. on Statics and Dynamics of Alloy Phase Transformations, Rhodes (Greece), 21 Jun. - 3 Jul. 1992
(Contract W-31-109-eng-38)
(DE93-001702; ANL/MSD/CP-77632; CONF-9206202-3) Avail: CASI HC A02/MF A01

Plastic crystal behavior is observed in semiconducting CsPb and NaSn at high temperature (600 and 500 C, respectively). This behavior is associated with M(sub 4)(sup 4(-)) or A(sub 4)M(sub 4) structural units orientationally disordering about 50 C below the melting point where translational disorder sets in. This orientational disorder is different in the two phases, exhibiting jump reorientations in CsPb and a more isotropic behavior in NaSn. In other Zintl compounds such as KPb, there is a single melting point where orientational and translational disorder sets in simultaneously; the classification of the different Zintl compounds into these two different kinds of behavior will require calorimetry or neutron diffraction below the melting point. DOE

N93-16989# Ames Lab., IA.
A SOLID STATE APPROACH TO THE PRODUCTION OF KILOGRAM QUANTITIES OF Si-20 AT. PERCENT Ge THERMOELECTRIC ALLOYS
B. A. Cook, J. A. Harringa, and B. J. Beaudry 1992 8 p Presented at the 10th Symposium on Space Nuclear Power and Propulsion, Albuquerque, NM, 10-14 Jan. 1993
(Contract W-7405-eng-82)
(DE92-018803; IS-M-720; CONF-930103-5) Avail: CASI HC A02/MF A01

A critical engineering question in the development of improved materials for thermal-to-electrical power generation is whether the research-scale process or methodology is amenable to production of kilogram quantities.

Research efforts on the solid state technique of mechanical alloying have shown that both n- and p-type Si-20 at. percent Ge alloys can be produced which have improved thermoelectric properties compared to state-of-the-art MOD-RTG materials. Studies on the production of large quantities of mechanically alloyed powder alloys using a planetary mill indicate that properties similar to those observed in alloys prepared in smaller quantities by a vibratory mill can be obtained. The characterization of several p-type alloys doped with 1 at. percent B in the form SiB4 by x-ray diffraction, scanning laser mass spectrometry, Hall effect, and high temperature electrical resistivity and Seebeck coefficient studies is described. The properties of these alloys are shown to be comparable with those measured on similar samples prepared in small quantities by a vibratory mill approach. DOE

N93-17031# Lawrence Livermore National Lab., CA.
FIRST-PRINCIPLES APPROACH TO ALLOY PHASE STABILITY
P. E. A. Turchi, L. T. Reinhard, and M. Sluiter 22 May 1992 9 p Presented at the International Conference on the Physics of Transition Metals, Darmstadt (Germany), 20-24 Jul. 1992
(Contract W-7405-eng-48)
(DE93-001323; UCRL-JC-110724; CONF-920762-7) Avail: CASI HC A02/MF A01

Order-disorder phenomena and structural transformations in substitutional alloys are studied with a proper combination of quantum mechanics and statistical thermodynamics. The methodology is briefly presented and its predictive capabilities are illustrated for various alloys, including the bcc-based Ti-V, Ti-Fe and Cr-Fe systems, in terms of electronic structure, ground-state and short-range order diffuse scattering properties, and finally phase diagram results. DOE

N93-17047# Sandia National Labs., Albuquerque, NM.
GENERATION OF AEROSOLIZED PARTICULATE CONTAMINATION BY THE WEAR OF STAINLESS STEELS
D. C. McIntyre, M. T. Dugger, and D. J. Rader 1992 12 p Presented at the Microcontamination 1992, Santa Barbara, CA, 23-30 Oct. 1992
(Contract DE-AC04-76DP-00789)
(DE93-000742; SAND-92-1769C; CONF-9210125-2) Avail: CASI HC A03/MF A01

Pin-on-disc testing was used to generate wear particles from 304 and 440 C stainless steels in presence of low-velocity interfacial air flows from a laminar flow bench. The aerosolized wear generated particles were studied using optical particle counters. In some cases, the particles were also collected using an electrostatic precipitator. The tests showed that 440 C pins in unlubricated sliding contact with 440 C discs and 304 discs generated mostly submicron particles, but that many of these submicron particles were detached from the wear surfaces as parts of agglomerated macro-particles. DOE

N93-17059# Sandia National Labs., Albuquerque, NM.
CHARACTERIZATION OF SOLIDIFICATION AND WELDABILITY OF Fe-29Ni-17Co ALLOYS
C. V. Robino, C. R. Hills, and P. F. Hlava 1992 21 p Presented at the Fall Meeting of the Metallurgical Society and American Inst. Metallurgical and Petroleum Engineers, Chicago, IL, 1-5 Nov. 1992
(DE93-000739; SAND-92-1958C; CONF-921109-2) Avail: CASI HC A03/MF A01

Applications for the controlled thermal expansion alloy Fe-29Ni-17Co often require joining by fusion welding processes. In addition, these applications usually require hermetic and high reliability joints. The small size of typical components normally dictates the use of autogenous welding processes, so that the hot cracking tendency of Fe-29Ni-17Co is of concern. The solidification behavior and hot cracking tendency of commercial Fe-29Ni-17Co has been evaluated using diffcrential thermal analysis (DTA), Varestraint testing, light and electron microscopy, and laser welding trials. DTA and microstructural analysis indicated that the solidification of Fe-29Ni-17Co occurs as single phase austenite, does not exhibit the formation of terminal solidification phases, and results in only minimal segregation of major alloying elements. Varestraint testing indicated that the hot cracking behavior of Fe-29Ni-17Co is similar to, though somewhat more pronounced than, 304L and 316 stainless steels. Relative to other Fe-Ni-Co and Ni-based alloys, however, the hot cracking response of this alloy is favorable. Pulsed laser welding trials indicated that the phosphorus and sulfur levels in this heat of Fe-29Ni-17Co were insufficient to promote cracking in bead-on-plate welds. DOE

N93-17083# Pennsylvania Univ., Philadelphia. Dept. of Materials Science and Engineering.
ATOMISTIC STUDIES OF GRAIN BOUNDARIES IN ALLOYS AND COMPOUNDS
V. Vitek Oct. 1992 34 p
(Contract DE-FG02-87ER-45295)
(DE93-002769; DOE/ER-45295/T2) Avail: CASI HC A03/MF A01

Atomic structure and atomic level properties of grain boundaries in binary alloys have been studied theoretically. Both ordered and disordered alloys were investigated with the aim of these studies to elucidate thos structural, chemical, and electronic features of grain boundaries in binary alloys that are responsible for different different physical and mechanical properties o f alloys when compared with pure metals. An integral part is atomic interactions. The first are the many-body potentials akin to the embedded atom method. The most important was the development of the potentials for Cu-Bi which combined empirical data and ab initio electronic structure calculations to construct reliable potentials. LMTO based tight-binding method were developed fully for pure metals with future application alloys. Structural studies were carried out for disordered Cu-Bi and ordered Ni3Al and Cu3Au alloys. In the former case, the investigation was linked with HREM, and result is the solution of structure of sigma = 3 (111)/(11(bar 1)) facets containing Bi formed during segregation from originally curved boundaries. In the latter case, the effect of ordering strength deviation from stoichiometry on the the boundary structure and its properties were investigated. The most interesting finding is a very different behavior of Ni rich and Al rich Ni3Al which may explain why only Ni rich compounds can be ductilized by boron. In both cases, the surplus element segregates to the boundaries. DOE

N93-17184# Washington Univ., Saint Louis, MO. Dept. of Physics.
MULTI-BODY FORCES AND THE ENERGETICS OF TRANSITION METALS, ALLOYS, AND SEMICONDUCTORS
A. E. Carlsson 1992 7 p
(Contract DE-FG02-84ER-45130)
(DE93-002230; DOE/ER-45130/7) Avail: CASI HC A02/MF A01

Progress over the past year is presented, and was in the following three areas: potential-energy functions for transition-metal aluminides; electronic structure and energetics of complex structures and quasicrystals; and ceramic materials (PdO, PtO). DOE

N93-17201# Wisconsin Univ., Madison.
ORGANOMETALLIC CHEMISTRY OF BIMETALLIC COMPOUNDS
C. P. Casey Jul. 1992 5 p
(Contract DE-FG02-85ER-13406)
(DE93-002773; DOE/ER-13406/7) Avail: CASI HC A01/MF A01

Hydrogenation of alkynes by the heterobimetallic compound C5H5(CO)2Re(mu-H)Pt(H)(PPh3)2 is being studied. The compound C5Me5(CO)2Re=Re(CO)2C5Me5 was synthesized; its chemistry is being studied. Compounds discovered in a reinvestigation of a spurious report of (C5Me5)Co=bond)Co(C5Me5), are being studied. The deuterioformylation of alkenes using wide bite angle phosphines will be studied. DOE

N93-17204# Los Alamos National Lab., NM.
EXPERIMENTAL AND NUMERICAL OPTIMIZATION OF THE U-Zr-C TERNARY PHASE DIAGRAM
D. P. Butt, T. C. Wallace, W. A. Stark, Jr., E. K. Storms, F. G. Hampel, M. A. Williamson, and P. D. Kleinschmidt 1992 17 p Presented at the 10th Symposium on Space Nuclear Power and Propulsion, Albuquerque, NM, 10-14 Jan. 1993
(Contract W-7405-eng-36)
(DE92-015242; LA-UR-92-1624; CONF-930103-1) Avail: CASI HC A03/MF A01

The U-Zr-C ternary-phase diagram is optimized using melting point and vapor pressure data recently measured at Los Alamos National Laboratory and by graphical and numerical curve fitting of self-consistent thermodynamic and phase diagram data reported in the literature. The system is described from 2473 K to 3693 K using isothermal ternary phase diagrams. The solidus and liquidus curves of the U(x)Zr(1-x)C(y) solid solution were estimated from combined thermodynamic and adjusted phase diagram data.

From the solidus and liquidus curves for the solid solution, the reversible heat transferred from the solid to the liquid phase for UC and ZrC were calculated to be 150 and 324 kJ/mol, respectively; and the maximum in the excess free energy for mixing was determined to be on the order of 1100 J/mol at 56 percent ZrC. DOE

N93-17341# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.
IRRADIATION-ASSISTED STRESS CORROSION CRACKING OF AUSTENITIC ALLOYS
G. S. Was and M. Atzmon 1991 39 p
(Contract DE-FG07-88ER-12825)
(DE92-040988; DOE/ER-12825/2) Avail: CASI HC A03/MF A01

An experimental program has been conducted to determine the mechanism of irradiation-assisted stress-corrosion cracking (IASCC) in austenitic stainless steel. High-energy protons have been used to produce grain boundary segregation and microstructural damage in samples of controlled impurity content. The densities of network dislocations and dislocation loops were determined by transmission electron microscopy and found to resemble those for neutron irradiation under LWR conditions. Grain boundary compositions were determined by in situ fracture and Auger spectroscopy, as well as by scanning transmission electron microscopy. Cr depletion and Ni segregation were observed in all irradiated samples, with the degree of segregation depending on the type and amount of impurities present. P impurities were observed to segregate to the grain boundaries. Irradiation was found to increase the susceptibility of ultra-high-purity (UHP), and to a much lesser extent of UHP+P and UHP+S, alloys to intergranular SCC in 288 C water at 2 ppm O2 and 0.5 microsec./cm. No intergranular fracture was observed in argon atmosphere, indicating the important role of corrosion in the embrittlement of irradiated samples. The absence of intergranular fracture in 288 C argon and room temperature tests also suggest that the embrittlement is not caused by hydrogen introduced by irradiation. Contrary to common belief, the presence of P impurities led to a significant improvement in IASCC over the ultrahigh purity alloy. DOE

N93-17346# Los Alamos National Lab., NM. Superconductivity Technology Center.
MAGNETIC HYSTERESIS AND FLUX CREEP OF YBa2Cu3O(x) GROWN BY THE MELT-POWER-MELT-GROWTH (MPMG) PROCESS
P. J. Kung (Carnegie-Mellon Univ., Pittsburgh, PA.), M. E. McHenry (Carnegie-Mellon Univ., Pittsburgh, PA.), M. P. Maley, J. O. Willis, M. Murakami (International Superconductivity Technology Center, Tokyo, Japan), and S. Tanaka (International Superconductivity Technology Center, Tokyo, Japan) 24 Aug. 1992 5 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-7405-eng-36)
(DE93-000870; LA-UR-92-3188; CONF-920802-19) Avail: CASI HC A01/MF A01

Magnetic hysteresis and flux creep of melt-powder-melt-growth (MPMG) YBa2Cu3Ox containing nominal 0, 25, and 40 mole percent Y2BaCuO5 (211) were measured in the temperature range of 5 to 80 K and in magnetic fields up to 5 T. With the introduced fine dispersion of second phase 211 particles, the critical magnetization current density J(sub c) shows a weak field dependence over a wide range of temperature, and the effective pinning energy U(sub eff) is much enhanced. From these results, a functional expression U(sub eff)(J,T) = -U(sub O)G(T)(J/J(sub i))(sup n) is obtained, where G(T) = (1 - (T/T(sub x))(sup 2))(sup 2) with T(sub x) = 82.5 K near the irreversibility temperature. The observed power-law relationship of U(sub eff)(J, T) clearly demonstrates two of three regimes as predicted by the theory of collective flux creep, namely n = 3/2 and 7/9 for J is less than J(sub c) and J is much less than J(sub c), respectively. In addition, the divergence of U(sub eff) at low current densities also suggests the existence of a vortex-glass state. DOE

N93-17392# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
OXIDATION AND VOLATILIZATION OF A NIOBIUM ALLOY
G. R. Smolik and K. A. McCarthy Jul. 1992 26 p
(Contract DE-AC07-76ID-01570)
(DE93-001927; EGG-FSP-10341) Avail: CASI HC A03/MF A01

This report presents the findings from a preliminary investigation into oxidation and volatilization characteristics of a niobium alloy. Niobium is a candidate alloy for use in plasma facing components (PFCS) in experimental fusion reactors like the International Thermonuclear Experimental Reactor (ITER). An experimental alloy was tailored to simulate small changes in chemistry which could result from transmutations from irradiation. The alloy was exposed in air and steam between 800 C and 1200 C. Volatilized products and hydrogen were collected and measured. Post-test examinations were also performed on the samples to determine the amount of material loss during the exposures. The obtained measurements of volatilization flux (g/sq m-s), hydrogen generation rates (liters/sq m-s), and recession rates (mm/s) are data which can be used for safety analyses and material performance to predict consequences which may result from an accident involving the ingress of air or steam into the plasma chamber of fusion reactor. In our volatility tests, only molybdenum and niobium were found at release levels above the detection limit. Although molybdenum is present at only 0.12 wt percent, the quantities of this element volatilized in air are nearly comparable to the quantities of niobium released. The niobium release in steam is only three to four times higher than that of molybdenum in steam. The hydrogen production of the niobium alloy is compared with other PFC materials that we have tested, specifically, beryllium, graphite, and a tungsten alloy. At high temperatures, the hydrogen production rate of the niobium alloy is among the lowest of these materials, significantly lower than beryllium. To understand what this means in an accident situation, modeling is necessary to predict temperatures, and therefore total hydrogen production. The INEL is currently doing this modeling. DOE

N93-17479# Oak Ridge National Lab., TN.
THE INFLUENCE OF LONG TERM THERMAL AGING ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF MODIFIED 9Cr-1Mo STEEL
C. R. Brinkman, B. Gieseke, D. J. Alexander, and P. J. Maziasz 1992 23 p Presented at the Microstructure and Mechanical Properties of Aging Materials, Detroit, MI, 2-5 Nov. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001373; CONF-9211110-1) Avail: CASI HC A03/MF A01

Results of room- and elevated-temperature tensile and creep tests are reported from tests conducted on three heats of Modified 9Cr-1Mo steel. The heats were thermally aged at various temperatures from 482 to 704 C and at aging times to 75,000 h (8.6 years). Tensile strain rates were also varied in order to determine strain rate sensitivity of tensile properties. Changes in the yield and tensile strengths occurred following exposure to these temperatures with decreases noted at the higher temperatures. The material showed a strain-rate sensitivity particularly at temperatures in excess of about 538 C due to the presence of what was believed to be strain aging. The tensile-strength data were parameterized in order to permit estimates of changes in both room- and elevated-temperature properties to be made following exposure for prolonged periods in service time. Estimates are given of the changes in yield and tensile strengths following isothermal exposure at several temperatures for 60 years of service. Observations are presented concerning microstructural and microcompositional changes as observed by conventional and transmission, analytical electron microscopy, and quantitative precipitate extraction. DOE

N93-17495# Ecole Nationale Superieure du Petrole et des Monteurs, Rueil-Malmaison (France). Centre des Materiaux Pierre Marie Fourt.
STUDY OF THE DIFFERENT OXIDATION STATES OF NICKEL BASE SUPERALLOYS [ETUDE DES DIFFERENTS STADES D'OXYDATION DE SUPERALLIAGES BASE NICKEL]
Regine Molins and Eric Andrieu Jul. 1991 42 p In FRENCH
(Contract DRET/ARMINES-87-017-01-012)
(ETN-92-92555) Avail: CASI HC A03/MF A01

Crack propagation is investigated in Inconel 718 nickel base alloy in the temperature range of 650 to 850 C. A high sensitivity to intergranular oxidation is observed. Inconel 718 is a turbine disk material which operates under severe corrosion environments. Both mechanical and chemical damage processes are taken into account to analyze the crack propagation mechanisms. Results from nickel base alloys differing in chemical composition and crystal structure are compared. The oxidation characteristics were investigated by transmission electron microscopy. The results demonstrated that the oxidation kinetics are modified by microstructural and chemical effects. At the first oxidation steps iron and nickel mixed oxides are observed. After 15 minutes oxidation, a chromium oxide film was detected. ESA

N93-17540# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

DAMAGE TOLERANCE BEHAVIOUR OF ALUMINIUM-LITHIUM SHEET ALLOYS

R. J. H. Wanhill Jun. 1991 9 p Presented at Conference on Materials Processing and Performance, Melbourne, Austalia, Sep. 1991

(NLR-TP-91244-U; ETN-92-92522) Avail: CASI HC A02/MF A01

An extensive evaluation of the damage tolerance properties of modern aluminum lithium (Al-Li) alloys is considered. The materials tested include damage tolerant tempers of the 2091 and 8090 alloy, and the high strength 2090 alloy. These were compared with conventional and widely used damage tolerant 2024-T3 alloy and the high strength 7075-T6 alloy. Qualification of Al-Li alloys for aerospace structures emphasizes the fracture and fatigue crack growth properties in the in-service inspectable damage tolerance regime. Fracture toughnesses, crack resistances, and fatigue crack growth properties of Al-Li and conventional sheet alloys were determined. The practical significance of the results is discussed, and the current status of Al-Li sheet alloys is indicated. A survey of a comprehensive qualification program that includes other properties besides those related to damage tolerance is included. ESA

N93-17560# Minnesota Univ., Minneapolis. Corrosion Research Center.

FUNDAMENTAL STUDIES OF STRESS DISTRIBUTIONS AND STRESS RELAXATION IN OXIDE SCALES ON HIGH TEMPERATURE ALLOYS

D. A. Shores, J. H. Stout, and W. W. Gerberich Jun. 1992 28 p

(Contract DE-FG02-88ER-45337)

(DE93-003654; DOE/ER-45337/5) Avail: CASI HC A03/MF A01

The high temperature x-ray diffraction system developed for this program is being used to measure the strains which develop during oxidation. This is being applied to Ni/NiO and Cr/Cr2O3. Our work suggests that the oxide and metal crystalline texture, anisotropic elastic modulus, and anisotropic thermal expansion can have a pronounced effect on strain state of these systems. Acoustic emission is being used to study oxide scale failure (fracture) during oxidation. AE data from 304 stainless steel are being used to develop a statistical model of fracture process. Strength of metal/scale interface is an important property that has been difficult to quantify. Using Nano-indentation and scratch techniques developed for characterizing thin film interfaces, an effort has begun to measure the fracture toughness of the metal/scale interface. Mathematical modeling of origin and time evolution of growth stresses is an extension and improvement of previous models. The current effort employs a more sophisticated stress analysis and expands the scope to include other stress relaxation processes. The interaction between the modeling studies and the x-ray diffraction measurements provides a natural credibility check to both efforts. DOE

N93-17578# Oak Ridge National Lab., TN.

SPIN DENSITY WAVES IN DILUTE CuMn ALLOYS

J. W. Cable and Y. Tsunoda (Osaka Univ., Toyonaka, Japan) 1992 11 p Presented at the Conference on Magnetism and Magnetic Materials, Houston, TX, 1-4 Dec. 1992

(Contract DE-AC05-84OR-21400)

(DE93-001628; CONF-921201-4) Avail: CASI HC A03/MF A01

Neutron scattering studies on concentrated CuMn alloys show static spin density waves (SDW) that are incommensurate with the lattice and which become dynamic above the freezing temperature T(sub f) with a dispersion relation that is essentially vertical. We have examined the existence of both the static and the dynamic SDW in dilute CuMn alloys where the Mn atoms may be separated beyond the range of SDW stability. There is no such cutoff range in the Overhauser SDW model where the transition temperature is simply linear with concentration, but a recent calculation by Ioffe and Feigel'man gives magnetic order that does depend on an interaction range and the density of spins on the lattice. For CuMn alloys, they obtain spin-glass ordering at low Mn concentration with a crossover to short-range helical order near 10 percent Mn. Our neutron scattering measurements were made on single crystals of CuMn alloys containing 1.4 and 3.0 percent Mn. Elastic scans along a group of zone axes (1 zeta 0) at temperatures well below T(sub f) yield the same type of intensity distribution as that previously observed for the more concentrated alloys and show the existence of static SDW at dilutions down to 1.4 percent Mn. Inelastic scans in the same Q region for the Cu-3 percent Mn alloy clearly show the presence of dynamic SDW at temperatures up to T/T(sub f) = 7.5. These results favor the SDW model of Overhauser as the best description of the magnetic order in dilute CuMn alloys. DOE

N93-17623# Pennsylvania State Univ., University Park.

TRANSITION METAL MEDIATED TRANSFORMATIONS OF SMALL MOLECULES

A. Sen 1992 22 p

(Contract DE-FG02-84ER-13295)

(DE93-001725; DOE/ER-13295/6) Avail: CASI HC A03/MF A01

Work on organotransition metal chemistry, homogeneous and heterogeneous catalysis is summarized. Several cationic palladium(II) complexes with bulky phosphine or pyridine ligands were discovered that are highly selective catalysts for linear dimerization of vinyl monomers and linear polymerization of p-divinylbenzene, the reactions proceeding through a carbocationic mechanism. Our studies were continued on alternating olefin-carbon monoxide copolymers. The copolymerization reaction and reactivity of copolymers were examined. New catalytic systems for alternating copolymerization of alpha-olefins with CO were discovered. In the case of styrene derivatives, tactic copolymers were obtained. Poly (ethylenepyrroledlyl) derivatives were synthesized from alternating ethylene-carbon monoxide copolymer and became electronic conductors when doped with iodine. A catalytic system for synthesis of polyureas and polyoxamides directly from carbon monoxide and diamines was also discovered. Pt metal catalyzed the oxidation of ethers, esters, and amines to carboxylic acids and the oxidation of olefins to 1,2-diols. Anaerobic and aerobic decomposition of molybdenum(VI)-oxoalkyl compounds were studied for heterogeneous oxidation of alkanes and olefins on Mo(VI)-oxide surfaces. Synthesis of polymer-trapped metal, metal oxide, and metal sulfide nanoclusters (less than 1-10 nm) was studied. DOE

N93-17667# Naval Postgraduate School, Monterey, CA.

THE DEFORMATION CHARACTERISTICS AND MICROSTRUCTURAL DYNAMICS OF AN Al-10Mg-0.1Zr ALLOY M.S. Thesis

James F. Buckley, II Jun. 1992 62 p

(AD-A257738) Avail: CASI HC A04/MF A01

An investigation into microstructural evolution during processing and superplastic deformation of an Al-10Mg-0.1Zr alloy was conducted. Processing schedules were modified to enhance particle-stimulated nucleation of recrystallization and refine subsequent gain size. Strain rates varying over three orders of magnitude were utilized in subsequent testing of processed material. At lower strain rates of about 10-4 sec-1 coarsening of the microstructure was apparent and elongations of 277 percent were obtained. A strain rate of 10-3 sec exp -1 resulted in lesser coarsening and elongations of 650 percent. A model of deformation by grain boundary sliding in association with microstructural coarsening is presented. GRA

N93-17704# Pratt and Whitney Aircraft, West Palm Beach, FL. Government Engines and Space Propulsion.

FATIGUE IN SINGLE CRYSTAL NICKEL SUPERALLOYS Technical Progress Report, 16 Sep. - 15 Oct. 1992

Charles Annis 15 Oct. 1992 7 p

(Contract N00014-91-C-0124)

(AD-A258038; PW/FR21998-12) Avail: CASI HC A02/MF A01

This program investigates the seemingly unusual behavior of single crystal airfoil materials. The fatigue initiation processes in single crystal (SC) materials are significantly more complicated and involved than fatigue initiation and subsequent behavior of a (single) macrocrack in conventional isotropic materials. The understanding of these differences is the major goal of this project. GRA

N93-17753# Brookhaven National Lab., Upton, NY.

THE ENERGETICS OF ORDERED INTERMETALLIC ALLOYS (OF THE TRANSITION METALS)

R. E. Watson, M. Weinert, J. W. Davenport, G. W. Fernando (Connecticut Univ., Storrs.), and L. H. Bennett (National Inst. of Standards and Technology, Gaithersburg, MD.) 1992 40 p Presented at the NATO Advanced Study Inst. on Statics and Dynamics of Alloy Phase Transformations, Rhodes, Greece, 21 Jun. - 3 Jul. 1992

(Contract DE-AC02-76CH-00016)

(DE93-001968; BNL-47976; CONF-9206202-4) Avail: CASI HC A03/MF A01

The atomically ordered phases in ordered transition metal alloys are

discussed. This chapter is divided into the following: physical parameters controlling phase stability (Hume-Rothery, structural maps, and Miedema Hamiltonian), wave functions & band theory, comment on entropy terms, cohesive energies (electron promotion energies and Hund's rule on orbital effects), structural energies/stabilities of elemental solids, total energies and atomic positions, charge transfer (Au alloys and charge tailing), heats of formation of ordered compounds. DOE

N93-17759# Pennsylvania State Univ., University Park. Materials Research Lab.
TWIN BOUNDARIES, INTERFACES AND MODULATED STRUCTURES IN MARTENSITES
G. R. Barsch 30 Sep. 1992 26 p Prepared in cooperation with Cornell Univ., Ithaca, NY
(Contracts DE-FG02-85ER-45214; DE-FG02-88ER-45364)
(DE93-002136; DOE/ER-45214/T5) Avail: CASI HC A03/MF A01

Theoretical studies were pursued with supporting experimental investigations (In-Tl) on the statics, dynamics, and statistical mechanics of twin boundaries, twin bands, and pretransformation structural modulations in proper and improper ferroelastic martensites. DOE

N93-15756# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany).
FATIGUE CHARACTERIZATION OF Ni-BASE ALLOYS
G. Marci *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 761-768 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-16767*# Norfolk State Univ., VA. Dept. of Chemistry and Physics.
FATIGUE DAMAGE STUDY IN ALUMINUM-2024 T3 ALLOYS
Milton W. Ferguson *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 97-98 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17304*# Indiana Univ. of Pennsylvania, Indiana, PA. Dept. of Physics.
ENERGETICS AND STRUCTURAL PROPERTIES OF TWIST GRAIN BOUNDARIES IN Cu
Majid Karimi *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N93-15667# Brookhaven National Lab., Upton, NY.
THE CHEMICAL POTENTIAL FROM EXTRINSIC IONS IN OXIDE FILMS ON ALUMINUM
H. S. Isaacs and A. J. Davenport 1992 5 p Presented at the 182d Meeting of the Electrochemical Society, Toronto, Ontario, 11-16 Oct. 1992
(Contracts DE-FG05-89ER-45384; DE-AC02-76CH-00016)
(DE92-041313; BNL-47591; CONF-921036-6) Avail: CASI HC A01/MF A01

X-ray studies of Cr in Al oxide films have shown that 3- and 6-valent Cr may be present. 300 nm Al films were anodized, cathodized or exposed to K3Cr(CN)6, NaMoO4, KMnO4, or NaVO3 solutions. Cathodized surfaces were then anodized in borate solution. X-ray absorption at glancing angle and fluorescence detection were used to study species incorporated in the oxide surface. The 3-valent Cr present was closely related to Cr(OH)3. Absence of a pre-edge peak associated with the 6-valent Cr shows that conditions at the oxide surface did not produce chromates. Cr(CN)6(sup 3-) complex is not strongly absorbed on the surface, in contrast to chromates. The permanganate and vanadate solutions gave only 4-valent Mn and 5-valent V. The effective oxidation potential inside the oxide film is estimated. DOE

N93-15671# Oak Ridge National Lab., TN.
COMBINED SMALL-ANGLE NEUTRON AND X RAY SCATTERING STUDIES OF POLYMERS
G. D. Wignall 1992 19 p Presented at the 41st Annual Denver X Ray Conference, Denver, CO, Aug. 1992
(Contract DE-AC05-84OR-21400)
(DE93-000440; CONF-9208129-3) Avail: CASI HC A03/MF A01

Over the past two decades, small-angle neutron scattering (SANS), using cold neutrons (4-20 angstroms), has proven to be an important tool for the evaluation of polymer chain conformation. Due to a fortuitous combination of several factors (penetrating power, deuteration, solvent choice), SANS has developed into a very powerful tool for the study of polymers. This article focuses on the information provided by SANS and demonstrates how it has complemented and expanded upon the data available from other scattering techniques (e.g., SAXS). Applications to homogenous polymer mixtures, phase-separated polymer blends, and carbon-filled polymers are discussed. DOE

N93-15809# California Univ., Berkeley. Lawrence Berkeley Lab.
HIGH-PERFORMANCE, NON-CFC-BASED THERMAL INSULATION: GAS FILLED PANELS
B. T. Griffith, D. Arasteh, and S. Selkowitz Apr. 1992 23 p
(Contract DE-AC03-76SF-00098)
(DE93-001525; LBL-31633; CIEE-2) Avail: CASI HC A03/MF A01

Because of the forthcoming phase-out of CFCs and to comply with the more stringent building and appliance energy-use standards, researchers in industry and in the public sector are pursuing the development of non-CFC-based, high-performance insulation materials. This report describes the results of research and development of one alternative insulation material: highly insulating GFPs. GFPs insulate in two ways: by using a gas barrier envelope to encapsulate a low-thermal-conductivity gas or gas mixture (at atmospheric pressure), and by using low-emissivity baffles to effectively eliminate convective and radiative heat transfer. This approach was used successfully to produce superinsulated windows. Unlike foams or fibrous insulations, GFPs are not a homogeneous material but rather an assembly of specialized components. The wide range of potential applications of GFPs (appliances, manufactured housing, site-built buildings, refrigerated transport, and so on) leads to several alternative embodiments. While the materials used for prototype GFPs are commercially available, further development of components may be necessary for commercial products. With the exception of a description of the panels that were independently tested, specific information concerning panel designs and materials is omitted for patent reasons; this material is the subject of a patent application by Lawrence Berkeley Laboratory. DOE

N93-15814# New Mexico Inst. of Mining and Technology, Socorro. Center for Explosives Technology Research.
DYNAMIC FABRICATION OF DIAMOND THERMAL MANAGEMENT SUBSTRATES Progress Report
11 Sep. 1992 2 p
(Contract N00014-91-C-2173)
(AD-A257213) Avail: CASI HC A01/MF A01

Two sets of experiments on the recently purchased batch of GE synthetic diamond power obtained from Dubbledee Harris Diamond Corporation are scheduled for this month. Powders of controlled particle size distribution have been acquired to yield maximum initial packing densities (greater than 70 percent) The powders have been treated at 800 deg C in argon atmosphere, similar to previous heat-treatments. Fluorinated diamond powders, and diamond powders mixed with approx. 10 percent melamine formaldehyde copolymer will also be tested in these experiments. We continue to analyze the previous shock compacted diamond samples, via Raman, x-ray diffraction, and electrical resistivity. Based on these tests, several other samples have been isolated to send to CalTech for thermal conductivity measurements. GRA

N93-15861# Rockwell International Science Center, Thousand Oaks, CA.
HIGH TEMPERATURE REACTION KINETICS OF BORON OXIDES Annual Report No. 1, 15 Jun. 1991 - 14 Jun. 1992

Allen Twarowski Jun. 1992 9 p
(Contract F49620-91-C-0057)
(AD-A257402; SC71053.AR) Avail: CASI HC A02/MF A01

Experiments using laser photolysis of water vapor to probe H + OH recombination chemistry in a mixture of combustion products of hydrogen, oxygen and phosphine are reported. When combustion products of phosphine are present, a large increase in the apparent H + OH recombination rate is observed. Progress was made in determining a baseline reaction model which describes the observed reaction rate. The thermochemical properties of 17 simple phosphorus species (possible combustion products of phosphine and oxygen) were assembled and the equilibrium densities of the phosphorus species were calculated under typical test conditions. The thermochemical properties of many of the phosphorus species have not been previously determined and were estimated from the results of ab initio quantum chemical calculations available in the literature. The six phosphorus species with the largest densities were used in the construction of a reaction model. Rate constant values were estimated using standard methods for the metathesis reactions and using simplified RRKM calculations to estimate the rates of recombination reactions. The increase in the observed rate of OH recovery was well described by this reaction set at the experimental conditions of 1970 K and 532 Torr. Two phosphorus containing recombination reactions appear to be rate limiting for H + OH recombination. GRA

N93-15866# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
MECHANICAL PROPERTIES OF STRUCTURAL POLYMERS. COMPUTER SIMULATIONS AND KEY EXPERIMENTS Technical Report, 1 Sep. 1986 - 30 Sep. 1992
Ali S. Argon 30 Sep. 1992 10 p
(Contract N00014-86-K-0768)
(AD-A257439) Avail: CASI HC A02/MF A01

In terms of molecular microstructures and morphology, polymers are some of the most complex engineering materials. They offer, however, vast potential in structural applications, in both monolithic form as well as matrices in composite materials. Through chemical synthesis new polymers are being put together routinely in large numbers. In this quest, the understanding of their physical properties and, more seriously, their mechanical properties have lagged behind - often resulting in inadequate exploitation of the full potential of existing polymers. While the physics and chemistry of polymers have received more serious attention, the mechanical properties have been studied largely phenomenologically without adequately relating these properties through the relevant mechanisms to the microstructure or morphology. To rectify this deficiency and to elucidate the mechanisms that govern the mechanical properties of polymers, a long range fundamental study was initiated in 1986 through the opportunity offered by the DARPA University Research Initiatives Program. GRA

N93-15908# Cornell Univ., Ithaca, NY. Dept. of Materials Science and Engineering.
NANOGRAIN SUPERPLASTICITY IN CERAMICS Final Report, 1 Sep. 1989 - 30 Jun. 1992
Rishi Raj 15 Sep. 1992 11 p
(Contract DAAL03-89-K-0132)
(AD-A256643; ARO-26747.2-MS-A) Avail: CASI HC A03/MF A01

The objective of this research program has been to understand whether or not nanograin ceramic materials are capable of exhibiting unusual superplasticity, and if so, then is this phenomenon general or is it limited to a few special types of ceramics. The first part of the research required implementation of the method to process high quality, glass-free ceramic specimens from different chemistries and to test their superplastic properties at over a wide range of high temperatures and strain rates. The PVD method combined with lithography was chosen and developed for making specimens from different ceramic materials. The report summarizes the results from ultra finegrained specimens of magnesium aluminate spinel and yttria-stabilized zirconia. After testing many different compositions we have found that so far only these two (glass free ceramics) are capable of sustaining substantial superplastic strain in tensile deformation. These results point toward the possibility that interfaces in non-stoichiometric ceramics have greater resistance to fracture than in stoichiometric ceramics. GRA

N93-15911# SRI International Corp., Menlo Park, CA.
TESTS FOR DETERMINING FAILURE CRITERIA OF CERAMICS UNDER BALLISTIC IMPACT Final Report, 1 Oct. 1988 - 29 Feb. 1992
Richard W. Klopp and Donald A. Shockey Jun. 1992 137 p
(Contract DAAL03-88-K-0200)
(AD-A256652; ARO-26173.4-MS-A) Avail: CASI HC A07/MF A02

A three-year Balanced Technology Initiative (BTI) program to develop tests for determining the failure criteria of ceramics under ballistic impact is described. The phenomenology of the penetration of a confined ceramic block by a long rod penetrator was established by examining the fracture damage in targets after ballistic testing. The material properties that govern the penetration resistance of ceramics were deduced. Two plate impact tests-the high-strain-rate pressure/shear test and the symmetric pressure/shear test-were then developed to measure the granulation and granular flow properties of candidate armor ceramics at strain rates and pressures representative of those at the tip of an advancing penetrator. In the development of the tests, a laser-Doppler velocimeter was applied for the first time to measure the transverse motion of the target plate. The tests were applied to aluminum nitride, boron carbide, and Coors AD-85 and AD-995 aluminas; and the resultant behaviors were compared. Two one-dimensional computational models, one based on a continuum Mohr-Coulomb description of the flow of granulated ceramic and the other (developed in a companion BTI project) based on the frictional sliding of blocks, were applied to interpret the symmetric pressure/shear tests, which revealed the near-penetrator failure behavior. The observations and data were used as input for two-dimensional penetration simulations using the block-sliding model. GRA

N93-15930# California Univ., Berkeley. Lawrence Berkeley Lab.
TEMPERATURE HISTORY AND MICROSTRUCTURE OF ALUMINA Ph.D. Thesis
Jiang Tsair Lin May 1992 116 p
(Contract DE-AC03-76SF-00098)
(DE92-041196; LBL-32510) Avail: CASI HC A06/MF A02

A simple process for the attainment of fully dense and improved microstructure for Al2O3 ceramics has been developed. Pure, narrow size distribution, submicron powder is used. Homogenization heat treatment of Al2O3 powder compacts at 800 C for 50 hours produces more uniform pore structure and higher green strength. Pore size distribution becomes narrower. Near fully dense, fine grained (less than 1.2 micron) and uniform grain size distribution, undoped Al2O3 ceramics can be produced using a high quality powder, a high pressure cold isostatic forming method, and a two step sintering technique. Improvements in the microstructure of Al2O3 ceramics homogenized at 800 C/50 h include a smaller pore size and a more uniform pore size distribution. Prevention of differential densification in the early stages and delay of pore channel closure to the later stages of sintering are believed to be the primary mechanisms for the microstructure improvement in two-step sintering. Two-step sintering is an alternate way to improve the microstructure of Al2O3 ceramics compared to fast firing or MgO doping. When a homogenization heat treatment and the fast firing are combined, the final density is higher than from fast firing alone. However, the two-step sintering technique is simple and there is no size limit. Generalization of two-step sintering to more systems is needed. For 250 ppM MgO-doped Al2O3 ceramics, homogenization of powder compacts at 800 C for 50 hours produces 0.80 micron. This improvement is explained by the distribution of MgO becoming more uniform during the homogenization heat treatment, which enhances the effectiveness of MgO doping. DOE

N93-15957# California Univ., Berkeley. Lawrence Berkeley Lab.
INTERACTION IN POLYSILAZANE/SiC POWDER SYSTEMS Ph.D. Thesis
Y. P. Boiteux Jul. 1992 121 p
(Contract DE-AC03-76SF-00098)
(DE92-041178; LBL-32689) Avail: CASI HC A06/MF A02

Consolidation of ceramic precursor ceramic powder systems upon heating is investigated. A polysilazane (silicon nitride precursor) is chosen as ceramic precursor with a filler of a sub-micron SiC powder. A scheme to optimize the volume fraction of precursor is developed in order to maximize the density of the compacted samples in the green state. Different techniques are presented to improve the homogeneity of precursor distribution in the mixture. A microencapsulation technique is developed that leads to a uniform coating of precursor on individual SiC particles.

Upon pyrolysis of systems with 20 wt percent polysilazane, little shrinkage occurs. The SiC particles do not coarsen during the heat treatment. The precursor, upon pyrolysis, transforms into an amorphous ceramic phase that acts as a cement between SiC particles. This cement phase can remain amorphous up to 1500 C and is best described as a siliconoxycarbide with or without traces of nitrogen. Elimination of nitrogen in the amorphous phase indicates that the filler material (SiC) has a strong influence on the pyrolysis behavior of the chosen polysilazane. The amorphous ceramic phase may crystallize between 1400 and 1500 C, and depending on the nature of the gas environment, the crystalline phases are SiC, Si, or Si3N4. Mechanisms explaining the strength increase upon heat treatment are proposed. Redistribution of the precursor occurs by capillary forces or vapor phase diffusion and recondensation of volatile monomers. The confined pyrolysis of the precursor results in an increase of residual ceramic matter being decomposed inside the sample. Interfacial reaction between the native silica-rich surface layer on SiC particles and the precursor derived phase explains the high strength of the materials. DOE

N93-15966# Science Applications International Corp., Marietta, GA.
ENVIRONMENTALLY COMPLIANT THERMOPLASTIC POWDER COATING, PHASE 1 Interim Engineering Report, 23 Oct. 1991 - 31 Mar. 1992
Douglas Neale, Douglas Bruner, and David Butler 7 Oct. 1992 116 p
(Contract F09603-90-D-2215)
(AD-A257232; SAIC-0100-Phase-1; WRALC-CN-04-Phase-1) Avail: CASI HC A06/MF A02

This interim report covers the evaluation of vendors and manufacturers of thermoplastic powder coating (TPC) equipment, materials, and technology. Assess the magnitude of the corrosion problems at several Air Force Bases in a severely corrosive environment. Determine what potential equipment would benefit from the TPC system to replace the current solvent-borne coating systems used on munitions, munitions handling equipment, mobile communications and electronic support equipment, and aerospace ground equipment (AGE). Evaluate the TPC flame sprayed application equipment and ethylene acrylic acid (EAA) and ethylene methacrylic acid (EMAA) copolymers thermoplastic powder. GRA

N93-16005# Aerospace Corp., El Segundo, CA. Mechanics and Materials Technology Center.
STRUCTURAL AND TRIBOLOGICAL STUDIES OF MoS2 SOLID LUBRICANT FILMS HAVING TAILORED METAL-MULTILAYER NANOSTRUCTURES
M. R. Hilton, R. Bauer, S. V. Didziulis, M. T. Dugger, and J. M. Keem 15 Dec. 1991 36 p
(Contract F04701-88-C-0089)
(AD-A257218; TOR-0091(6064)-2) Avail: CASI HC A03/MF A01

Molybdenum disulfide (MoS2) solid lubricant films were prepared by rf magnetron sputtering on 440 C steel, 52100 steel, and Si substrates. This study concentrated on films that were multilayer coatings of MoS2 with either Ni or Au-Pd(20 pct.) metal interlayers. Multilayer thickness ranged from 0.2 to 1.0 nm while the multilayer periodic spacing ranged from 3 to 10 nm. Scanning electron microscopy and X ray diffraction revealed that the multilayer films had dense microstructures that, in some cases, exhibited significant orientation of their basal planes parallel to the substrate. Film endurance was assessed in sliding contact by using thrust washer tests and in rolling contact by using thrust bearing tests. Some film microstructures exhibited excellent endurance. Brale indentation indicated that the metal layers can improve film fracture toughness. Friction in air and ultra-high vacuum (UHV) was investigated using a UHV compatible test apparatus. Friction coefficients between 0.05 and 0.08 were measured in UHV. GRA

N93-16032# California Univ., Berkeley. Lawrence Berkeley Lab.
CORROSION-RESISTANT COATINGS FOR HIGH-TEMPERATURE HIGH-SULFUR-ACTIVITY APPLICATIONS
J. R. Selman, B. Aladjov, and B. Chen (Illinois Inst. of Tech., Chicago.) Jan. 1992 30 p
(Contract DE-AC03-76SF-00098)
(DE93-001527; LBL-32234) Avail: CASI HC A03/MF A01

The previously started experiments to verify the feasibility of obtaining molybdenum and molybdenum carbide coatings from oxide-based melts were continued. A molten salt bath consisting of an equimolar mixture of Na2WO4 and K2WO4 was used. The molybdenum and carbon species were introduced as alkali molybdate and carbonate. The coating morphology depends strongly on melt composition, temperature and moisture content. Application of initial pre-electrolysis significantly changes the composition and morphology of the coatings. Using non-lithium alkali salts, coatings of better quality were obtained. Adding 3-8 mol percent Na2B4O7 to the basic non-lithium bath composition was observed to cause significant morphology and quality changes. Bath compositions produce a more uniform small-grain-size coating and they do not require extensive purification. Constant current and reverse and/or pulse current patterns were applied during plating. The latter produces smaller-grain-size coatings at the same working temperature. Research was undertaken to deposit Mo and Mo2C films on a substrate 2.5 cm by 3.8 cm in area. Using an orthogonal factorial design, a new series of experiments has been carried out to investigate the effect of the evaporation rate of Mo(CO)6 as a precursor. From the weight gain of the substrate, initial conclusions have been drawn about the optimal conditions for maximum evaporation rate, deposition rate and thickness. Thicker coatings (a few micron) have been obtained which show two different types of crystallites growing on an initially amorphous film. A two dimensional transport and reaction kinetics model for a parallel-plate PECVD reactor was outlined. The PECVD results will be used to verify the model. The primary parameters to be explored are those representing the deposition kinetics of Mo and C. DOE

N93-16042# Little (Arthur D.), Inc., Cambridge, MA.
NON-INERT REFRIGERANT STUDY FOR AUTOMOTIVE APPLICATIONS
J. T. Dieckmann, J. Bentley, and A. Varone Nov. 1991 75 p
(Contract DE-AI01-89CE-50274)
(DE92-041034; DOE/CE-50274/T1) Avail: CASI HC A04/MF A01

Alternatives to CFC-12 for automobile air conditioning were examined. The list of candidate fluids included flammable as well as non-flammable substances. HFC-134a was taken as the baseline alternative given current industry plans to convert automobile air conditioning systems to this fluid over the next several years. Three flammable (non-inert) alternative refrigerants--BFC-152a, HC-290 (propane), and HC-270 (cyclopropane) were identified. Air conditioning cycle efficiency, ozone depletion potential, and global warming impacts of these three fluids and HFC-134a were compared, with the three non-inert fluids all having higher COP and lower global warming impact. The ozone depletion potential of each of these fluids is zero. The fire safety implications of the flammable alternatives being used in otherwise conventional automobile air conditioning systems were examined in preliminary fashion. The results, which are subject to more extensive verification indicate that the additional passenger compartment fire risk would be very small, while the incidence of engine compartment fires would increase modestly. The engine compartment fire hazard could be minimized by modest design changes to reduce the occurrence of ignition sources and condenser punctures in front end collisions. DOE

N93-16058# Integral Technologies, Inc., Westmont, IL.
EFFECT OF TRANSLUCENCE OF ENGINEERING CERAMICS ON HEAT TRANSFER IN DIESEL ENGINES
S. Wahiduzzaman and T. Morel Apr. 1992 131 p Prepared for Oak Ridge National Lab., TN
(Contract DE-AC05-84OR-21400)
(DE92-041384; ORNL/Sub-88-22042/2) Avail: CASI HC A07/MF A02

This report describes the experimental portion of a broader study undertaken to assess the effects of translucence of ceramic materials used as thermal barrier coatings in diesel engines. In an earlier analytical work, a parametric study was performed, varying several radiative properties over ranges typical of engineering ceramics, thereby identifying the most important radiative properties and their impact on in-cylinder heat transfer. In the current study, these properties were experimentally determined for several specific zirconia coatings considered for thermal barrier applications in diesel engines. The methodology of this study involved formulation of a model capable of describing radiative transfer through a semitransparent medium as a function of three independent model parameters, i.e., absorption coefficient, scattering coefficient, and refractive index. For the zirconia-based ceramics investigated in this study, it was concluded that for usual coating thicknesses (1.5-2.5 mm) these ceramics are optically thick and hence, are effective as radiative heat transfer barriers. These ceramics possess high scattering coefficients and low absorption coefficients causing them to be highly reflective (60-80 percent) in the spectral region where thermal radiation is important. The performance of the investigated ceramics and

the mechanism of heat transfer were found to depend on surface condition, specifically on soot deposition. Thus, to insure the optimum thermal barrier operation for either clean or heavily sooted surfaces, a ceramic material with a high scattering coefficient provides the best choice. DOE

N93-16060# Geo-Centers, Inc., Newton, MA.
SYNTHESIS AND EVALUATION OF POLYMERIC MATERIALS Annual Report No. 1, 30 Sep. 1990 - 30 Apr. 1992
E. Greenawald, J. Nagode, H. Hu, L. Levenberry, and R. Newbegin 30 Jun. 1992 258 p
(Contract N00014-90-C-2269)
(AD-A255563; GC-TR-92-2303) Avail: CASI HC A12/MF A03

GEO-CENTERS, Inc. has been supporting the research efforts at the Naval Research Laboratory including novel fluoropolymers, conductive polymers, epoxies, and modified nylons. Major efforts were conducted in radiographic analysis development and use in evaluation of Sonar Rubber Domes (SRD) and Sonar Dome Rubber Windows (SDRW). This report is a summary of accomplishments for the first year of the contract period of performance. GRA

N93-16073# Army Lab. Command, Watertown, MA. Material Technology Lab.
COMPUTER SIMULATIONS OF EPOXY ADHESIVE MONOMER INTERACTIONS WITH ALUMINA SURFACES Final Report
Michael S. Sennett, Walter X. Zukas, and Stanley E. Wentworth Aug. 1992 26 p
(AD-A257119; MTL-TR-92-54) Avail: CASI HC A03/MF A01

The effects are examined of aluminum oxide on the cure chemistry of epoxy adhesives. The project includes the use of molecular dynamics (MD) techniques to carry out real time simulations of the interaction of various epoxy adhesive monomers with idealized alumina surfaces. Adhesive monomers investigated include the diglycidyl ether of bisphenol A (DGEBA), a brominated form of DGEBA, diaminodiphenyl sulfone (DDS) and methylene dianiline (MDA). Both crystalline and amorphous forms of alumina at different levels of hydration have been simulated. The simulations illustrate the preferred orientations of the organic molecules with respect to the alumina surfaces and suggest which functional groups are most influential in determining this orientation. The model and experimental systems correlate well, showing similar response to changes in organic molecular structure, alumina morphology, and level of hydration. Model studies of this type can aid the understanding of the critical interphase region of adhesive bonds, including factors which affect bond durability, and have the potential to be used in the design of improved adhesives. GRA

N93-16095# Phillips Lab., Edwards AFB, CA.
PROCEEDINGS OF THE FIRST ANNUAL ADVANCED POLYMER COMPONENTS SYMPOSIUM Interim Report
John J. Rusek Jul. 1992 381 p Proceedings held in Indianapolis, IN, 20-22 Feb. 1992
(AD-A256679; AD-E201131; PL-TR-92-3018) Avail: CASI HC A17/MF A03

Advanced propulsion concepts rely on advanced propulsion materials. The Phillips Laboratory is aggressively pursuing advanced polymeric materials for use in solid, liquid, and nuclear propulsion component applications. Traditional composite materials have high specific strengths, but suffer from high cost and labor intensive processing. The APC program is currently exploring thermotropic liquid crystal polymers. These materials have high specific strength and can be economically processed by traditional high volume routes such as injection molding and blow moldings. Applications envisioned for these materials include rocket nozzles, pressure cases, propellant tanks and conduits, nuclear propulsion containment fairings, high pressure tanks and orbit-processed habitats for interplanetary voyages. These proceedings deal with an overview of liquid crystal polymer technology and current art, test article demonstrations and in-depth discussions of the so-called annealing phenomena. GRA

N93-16133# Rockwell International Corp., Thousand Oaks, CA.
MECHANISMS OF MECHANICAL FATIGUE IN CERAMICS
B. Cox Oct. 1992 6 p
(Contract DE-FG03-89ER-45400)
(DE93-001726; SC-71014-ATR/T4; DOE/ER-45400/T4) Avail: CASI HC A02/MF A01

This report covers work done in the second twelve month period of our initial two-year contract on Mechanisms of Mechanical Fatigue in Ceramics. A large portion of our work in that period consisted of developing the theory of bridged cracks, with especial emphasis on interpreting fatigue and fracture experiments in terms of micromechanical mechanisms. In the experimental area, we shifted our focus away from room temperature tests of metal reinforced ceramics such as WC/Co to high temperature testing of fibrous composites. We also participated in a major review of experimental progress in the fatigue of ceramic materials through an international conference, edited proceedings, and a published review. DOE

N93-16142# Dalhousie Univ., Halifax (Nova Scotia). Dept. of Physics.
ADHESION IN ATOMIC SCALE METAL CONTACTS
L. C. Wang, H. J. Kreuzer, U. During, and O. Zuger 6 Oct. 1992 16 p
(Contract N00014-80-J-1796)
(AD-A257137; TR-8) Avail: CASI HC A03/MF A01

The adhesion interaction of an Ir tip with Ir and Al surfaces has been investigated using the scanning tunneling microscope. Qualitative differences in the adhesion characteristics have been observed. A cluster model based on effective pair-potentials has been set up to understand adhesion in atomic scale contacts. The model calculation provides a semi-quantitative explanation of the experimental data. In particular, it is shown that subtle differences of the atomic interaction potentials have a significant effect on the contact mechanics. GRA

N93-16156# Institute for Defense Analyses, Alexandria, VA.
THE DARPA HIGH-PERFORMANCE POLYMER PROGRAM. VOLUME 2: APPENDIX: SELECTED PRESENTATION MATERIAL FROM THE PROGRAM REVIEW HELD ON 14-15 JANUARY 1992 Final Report, Dec. 1991 - Jul. 1992
David R. Squire and George Mayer Sep. 1992 675 p
(Contract MDA903-89-C-0003)
(AD-A257309; IDA-D-1174-Vol-2; IDA/HQ-92-42553-Vol-2; AD-E501579)
Avail: CASI HC A99/MF A06

In a series of projects dating back to 1984, the Defense Advanced Research Projects Agency (DARPA) has instigated research in advanced polymers including such goals as thermally oxidatively stable matrix resins for 700 F composite applications, rigid molecular composites, liquid crystal displays, and piezoelectric sensors. Volume 2, intended as a comprehensive reference source document, is an appendix which provides the program review agenda, a list of participants, and copies of selected presentation material. Correspondence from the presenters is included with the presentation material where appropriate. GRA

N93-16190# Institute for Defense Analyses, Alexandria, VA.
THE DARPA HIGH-PERFORMANCE POLYMER PROGRAM. VOLUME 1: PROGRAM BACKGROUND AND HIGHLIGHTS OF THE PROGRAM REVIEW HELD ON 14-15 JANUARY 1992 Final Report, Dec. 1991 - Jul. 1992
David R. Squire and George Mayer Sep. 1992 33 p
(Contract MDA903-89-C-0003)
(AD-A257308; IDA-D-1174-Vol-1; IDA/HQ-92-42552-Vol-1; AD-E501580)
Avail: CASI HC A03/MF A01

In a series of projects dating back to 1984, the Defense Advanced Research Projects Agency (DARPA) has instigated research in advanced polymers including such goals as thermally oxidatively stable matrix resins for 700 F composite applications, rigid molecular composites, liquid crystal displays, and piezoelectric sensors. Volume 1 of the present report reviews the history and accomplishments of the DARPA High-Performance Polymer Program and presents highlights of the program review conducted by DARPA on 14-15 January 1992. Volume 2, intended as a comprehensive reference source document, is an appendix which provides the program review agenda, a list of participants, and copies of selected presentation material. Correspondence from the presenters is included with the presentation material where appropriate. GRA

N93-16192# Spauschus Associates, Inc., Atlanta, GA.
CHEMICAL AND THERMAL STABILITY OF REFRIGERANT-LUBRICANT MIXTURES WITH METALS
D. F. Huttenlocher 10 Jul. 1992 63 p
(Contract DE-FG02-91CE-23810)
(DE93-000537; DOE/CE-23810/3B) Avail: CASI HC A04/MF A01

This report presents completed sealed tube stability test results for the following eight refrigerant/lubricant mixtures: R-22/mineral oil; R-124/alkylbenzene; R-134a/pentaerythritol (PE) ester (mixed acid); R-134a/PE (branched acid); R-134a/PE (100 cSt viscosity); R-142b/alkylbenzene; R-143a/PE (branched acid); R-152a/alkylbenzene. Partial results are shown for an additional eight refrigerant-lubricant mixtures. Though work is in progress, no data are available at this point in time for the five remaining test mixtures. Reported are: visual observations on aged sealed tubes, gas chromatographic analyses on the vapor phase contents of the tubes, chloride ion contents of HCFC containing mixtures or fluoride ion contents of HFC mixtures, and total acid number values and infrared analysis results for mixtures containing ester lubricants. DOE

N93-16212# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

AN INTRODUCTION TO THE RUBBER FORMING OF THERMOPLASTIC COMPOSITES

L. M. J. Robroek Feb. 1992 57 p

(LR-683; ETN-92-92877) Avail: CASI HC A04/MF A01

A thermoforming technique known as rubber forming, developed to process Continuous Fiber Reinforced Thermo Plastics (CFRTP), is presented. To shape thermoplastic composite products, several subprocesses must take place during processing. Some of the thermoforming techniques with which this is currently done are pointed out. The main subprocesses of heating, pressurization, and forming in the rubber forming method are dealt with separately. The shaping of a flat laminate during a rubber forming cycle by the necessary forming forces is discussed. The influence of the process parameters temperature and pressure on the deformation of a thermoplastic laminate is shown to be important. Investigations indicate the large influence of several subprocesses in a rubber forming cycle on the mechanical properties of a CFRTP product. Heat transfer and pressurization were two important research items in the development of the rubber forming technique. They determine the composite product quality and have to be controlled to a high extent. ESA

N93-16228# Sandia National Labs., Albuquerque, NM.

APPLICATION OF GRAZING INCIDENCE X RAY DIFFRACTION TO POLYMER BLENDS

R. P. Goehner, M. F. Garbauskas (General Electric Co., Schenectady, NY.), and D. G. LeGrand (General Electric Co., Schenectady, NY.) 1992 5 p Presented at the 41st Annual Denver X-Ray Conference, Denver, CO, Aug. 1992

(Contract DE-AC04-76DP-00789)

(DE93-000709; SAND-92-1813C; CONF-9208129-4) Avail: CASI HC A01/MF A01

The physical properties of polymer blends consisting of one or more crystallizable components are affected by the microstructure of these materials. In particular, the degree of crystallinity can be influenced by processing parameters, and the crystallinity, as well as the phase distribution, may vary as a function of depth through an injection molded part Conventional x-ray diffraction techniques can provide information regarding both phase composition and degree of crystallinity, but, because of the relative transparency of these materials to wavelengths generally available in the laboratory, these techniques provide information representative of only the bulk. By employing parallel beam optics at varying grazing incidence angles, the x-ray sampling depth can be varied without loss of resolution. This technique can be used to vary the effective analysis depth from the top several hundred angstroms for low razing incidence to centimeters for transmission diffraction patterns. Grazing incidence techniques have found initial application in the characterization of thin metallic and ceramic films. This paper demonstrates the feasibility of using parallel beam to depth profile low atomic number materials. The specific application of this optics technique to the characterization of injection molded polymers, including a blend of bisphenol-A polycarbonate (PC) and polybutylene terephthalate (PBT), will be presented. DOE

N93-16244# Iowa State Univ. of Science and Technology, Ames. Dept. of Mechanical Engineering.

MISCIBILITY OF LUBRICANTS WITH REFRIGERANTS

M. B. Pate, S. C. Zoz, and L. J. Berkenbosch Jul. 1992 20 p

(Contract DE-FG02-91CE-23810)

(DE93-000538; DOE/CE-23810/3C) Avail: CASI HC A03/MF A01

Miscibility data is being obtained for a variety of non-CFC refrigerants and their potential lubricants. Ten different refrigerants and seven different lubricants are being investigated. Experiments are being performed in two phases: Phase 1 focuses on performing screening tests and Phase 2 consists of developing miscibility plots. The miscibility tests are being performed in a test facility consisting of a series of miniature test cells submerged in a constant temperature bath. The bath temperature can be precisely controlled over a temperature range of -50 to 100 C. The test cells are constructed to allow for complete visibility of lubricant-refrigerant mixtures under all test conditions. Early in this reporting period, new procedures for charging the lubricant and refrigerant into the cells for testing were adopted. All of the refrigerants and all but one of the lubricants have been received from the manufacturers. Data obtained to date includes that for R-134a, R142b, R-32, R-134, R-125, and R-143a with four lubricants, namely, two esters and two polypropylene glycols. DOE

N93-16245# Akron Univ., OH. Inst. of Polymer Science.

COMPATIBILITY OF REFRIGERANTS AND LUBRICANTS WITH ELASTOMERS

G. R. Hamed and R. H. Seiple Jul. 1992 236 p

(Contract DE-FG02-91CE-23810)

(DE93-000539; DOE/CE-23810/3E) Avail: CASI HC A11/MF A03

Information contained in this report is designed to assist the air-conditioning and refrigeration industry in the selection of suitable elastomeric gasket and seal materials that will prove useful in various refrigerant and refrigeration lubricant environments. Swell measurements have been made on approx. 50 pct. of the proposed elastomers (94) in both the lubricant (7) and refrigerant (10) materials. Swell behavior in the these fluids have been determined using weight and in situ diameter measurements for the refrigerants and weight, diameter and thickness measurements for the lubricants. Weight and diameter measurements are repeated after 2 hours and 24 hours for samples removed from the refrigerant test fluids and 24 hours after removal from the lubricants. DOE

N93-16246# Trane Co., LaCrosse, WI.

COMPATIBILITY OF REFRIGERANTS AND LUBRICANTS WITH MOTOR MATERIALS

R. Doerr and S. Kujak 23 Jul. 1992 18 p

(Contract DE-FG02-91CE-23810)

(DE93-000540; DOE/CE-23810/3D) Avail: CASI HC A03/MF A01

During this last quarter, evaluations were complete on the motor materials after 500-hr exposures to refrigerants CFC-123, HFC-134a and HCFC-22 at 90 C. Materials were also evaluated after exposure to nitrogen at 127 C to determine effect of the thermal exposure. Other exposures were started during this quarter with refrigerants HCFC-124, HFC-125, HFC-143a, HFC-32 and HFC-152a. One 500 hr exposure is set up per week and one is analyzed the same week. This will enable the completion of the 500 hour exposures by the end of the year. DOE

N93-16269# Oak Ridge National Lab., TN.

STRUCTURAL CHANGES INDUCED BY ELECTRON IRRADIATION IN GRAPHITE

J. Koike (Oregon State Univ., Corvallis.) and D. F. Pedraza 1992 21 p Presented at the 8th International Conference on TMS Beam Processing of Advanced Materials, Chicago, IL, 5 Nov. 1992

(Contract DE-AC05-84OR-21400)

(DE92-040863; CONF-921183-2) Avail: CASI HC A03/MF A01

Highly oriented pyrolytic graphite was irradiated at room temperature with 300 kV electrons. Transmission electron microscopy and electron energy loss spectroscopy were employed to study the structural changes produced by irradiation. The occurrence of a continuous ring intensity in the selected area diffraction (SAD) pattern obtained on a specimen irradiated with the electron beam parallel to the c-crystallographic axis indicated that microstructural changes had occurred. However, from the SAD pattern obtained for the specimens tilted relative to the irradiation direction, it was found that up to a fluence of 1.1 x 10(exp 27) e/sq m graphite remained crystalline. An SAD pattern of a specimen irradiated with the electron beam perpendicular to the c-axis confirmed the persistence of crystalline order. High resolution electron microscopy showed that ordering along the c-axis direction remained. A density reduction of 8.9 pct. due to irradiation was determined from the plasmon frequency shift. A qualitative model is proposed to explain these observations. A new determination of the threshold

displacement energy, E sub d, of carbon atoms in graphite was done by examining the appearance of a continuous ring in the SAD pattern at various electron energies. A value of 30 eV was obtained whether the incident electron beam was parallel or perpendicular to the c-axis, demonstrating that E sub d is independent of the displacement direction.
DOE

N93-16273# Oak Ridge National Lab., TN.
DEVELOPMENT OF A CREEP DEFORMATION AND LIFE PREDICTION MODEL FOR A HIPed SILICON NITRIDE CERAMIC
J. L. Ding (Washington State Univ., Pullman.), K. C. Liu, and C. R. Brinkman 1992 13 p Presented at the Annual Automotive Development Technology Contractors' Coordination Meeting, Dearborn, MI, 2-5 Nov. 1992
(Contract DE-AC05-84OR-21400)
(DE93-000980; CONF-9211101-1) Avail: CASI HC A03/MF A01

A mathematical model was developed for predicting creep deformation and creep-rupture time for a HIPed silicon nitride (Si3N4) ceramic subjected to thermal-mechanical loading in uniaxial tension at elevated temperatures. The model was formulated based on the deformation and rupture data obtained from a systematic experimental study on a single lot of GN-10 Si3N4; however, it is applicable in principle to other types of ceramic materials. The model consists of three rate-type of equations that describe changes of three variables representing creep strain, devitrification of second phase, and creep damage. Introduction of the devitrification and creep damage variables is a new approach in constitutive modelling of Si3N4 ceramics and has significantly enhanced the ability to predict effects of annealing on creep behavior and creep rupture lifetime. Although the proposed model is exploratory in nature, it has demonstrated the capability of describing the essential features of uniaxial creep and creep rupture behavior of the material subjected to both constant and stepwise-varied loading conditions as well as the effects of high temperature annealing on the subsequent creep and creep rupture behavior. The simplicity of the model makes the closed form solutions for constant or stepwise-varied loading possible and, therefore, facilitates adoption of the proposed model in the current engineering design and analysis methods. DOE

N93-16297# Oak Ridge National Lab., TN.
MICROWAVE PROCESSING OF CERAMICS: GUIDELINES USED AT THE OAK RIDGE NATIONAL LABORATORY
M. A. Janney, H. D. Kimrey, and J. O. Kiggans 1992 13 p Presented at the Material Research Society Spring Meeting, San Francisco, CA, 27 Apr. - 2 May 1992
(Contract DE-AC05-84OR-21400)
(DE92-040862; CONF-920402-56) Avail: CASI HC A03/MF A01

To make meaningful comparisons between conventional and microwave processing of materials, one must conduct experiments that are as similar as possible in the two environments. Particular attention must be given to thermal conditions, sample parameters, and furnace environment. Under thermal conditions, one must consider temperature measurement (pyrometer or thermocouple, sheath type, and arcing of thermocouples), thermal history (heating and cooling rates, thermal gradients), and exothermic reactions. Regarding sample parameters, one must consider sample size, and packing powders and insulation systems. With respect to furnaces, one must consider differences in atmosphere, impurities, and uniformity of heating. Examples will be drawn from diffusion, grain growth, sintering, nitridation, and drying experiments conducted at the Oak Ridge National Laboratory (ORNL) over the past six years. DOE

N93-16372*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
KINETICS OF HEXACELSIAN TO CELSIAN PHASE TRANSFORMATION IN SrAl2Si2O8
Narottam P. Bansal and Charles H. Drummond, III (Ohio State Univ., Columbus.) Nov. 1992 18 p Presented at the 94th Annual Meeting of the American Ceramic Society, Minneapolis, MN, 12-16 Apr. 1992; sponsored by the American Ceramic Society
(RTOP 510-01-50)
(NASA-TM-105913; E-7397; NAS 1.15:105913) Avail: CASI HC A03/MF A01

The kinetics of hexacelsian to celsian phase transformation in SrAl2Si2O8 have been investigated. Phase pure hexacelsian was prepared by heat treatment of glass flakes at 990 C for 10 h. Bulk hexacelsian was isothermally heat treated at 1026, 1050, 1100, 1152, and 1200 C for various times. The amounts of monoclinic celsian formed were determined using quantitative X-ray diffraction. Values of reaction rate constant, k, at various temperatures were evaluated from the Avrami equation. The Avrami parameter was determined to be 1.1, suggesting a diffusionless, one-dimensional transformation mechanism. From the temperature dependence of k, the activation energy for this reaction was evaluated to be 527 plus or minus 50 kJ/mole (126 plus or minus 12 kcal/mole). This value is consistent with a mechanism involving the transformation of the layered hexacelsian structure to a three-dimensional network celsian structure which necessitates breaking of the strongest bonds, the Si-O bonds. Author

N93-16398# Department of the Navy, Washington, DC.
NONLINEAR OPTICAL COMPOSITES OF METAL CLUSTER LADEN POLYMERS Patent Application
A. W. Olsen and Z. Kafafi, inventors (to Navy) 3 Jun. 1992 23 p
(AD-D015396; US-Patent-Appl-SN-892914) Avail: CASI HC A03/MF A01

Nonlinear optical composites with large third-order optical response composed of metal clusters uniformally dispersed in polymer are prepared by vapor deposition of a metal onto a cold support while simultaneously cocondensing a vapor of an organic material. Where the organic material is a monomer, it polymerizes either when it comes in contact of the metal and/or when the cold surface is warmed. The unpolymerized monomer is removed to yield a processable composite. When the organic material is a diluent, it deposits as a solid on the cold surface forming a dispersion of the solid metal clusters in the liquid diluent. A polymer solution is then mixed with the dispersion and the composite is formed after removal of the diluent and the solvent for the polymer. Author (GRA)

N93-16436# Department of the Navy, Washington, DC.
SURFACE EPOXIDATION OF ELASTOMERS Patent Application
C. M. Roland, inventor (to Navy), Irima Zemel, inventor (to Navy), and C. F. Poranski, inventor (to Navy) 23 Jun. 1992 21 p
(AD-D015457; US-Patent-Appl-SN-902749; Navy-Case-73856) Avail: CASI HC A03/MF A01

Surface epoxidized elastomeric articles containing unsaturation are obtained by immersing the articles in an epoxidizing solution for a time sufficient to epoxidize at least some surface unsaturation in the articles.
GRA

N93-16472 Department of the Navy, Washington, DC.
GLASSY BINDER SYSTEM FOR CERAMIC SUBSTRATES, THICK FILMS AND THE LIKE Patent
Douglas M. Mattox, inventor (to Navy) 30 Jun. 1992 5 p Filed 8 Nov. 1989
(AD-D015472; US-Patent-5,126,292; US-Patent-Appl-SN-437788; US-Patent-Class-501-17) Avail: US Patent and Trademark Office

A ceramic material for electronic circuit devices is sintered at less than or equal to 1000 deg C temperature. A filler material such as quartz and a glassy binder RO Al2O3-B2O3 are mixed together along with an appropriate glassy binder prior to firing. RO is drawn from the group of metal oxides MgO, Cao, Sro, BaO, ZnO or CdO and the glassy binders form no more than 40 vol percent of the ceramic material. The glassy binder has a suitable viscosity and other properties so that after it is mixed with the quartz filler, sintering occurs at the relatively low temperature. As a consequence, high conductivity conductors made of copper, silver and gold can be appropriately metallized prior to firing. The strength and low dielectric constant of the ceramic material make the material well adapted for ceramic substrates, thick films and the like which are used in VHSIC and VLSI applications. GRA

N93-16475# Universiteit Twente, Enschede (Netherlands).
MICROSTRUCTURE, FRACTURE TOUGHNESS, AND STRENGTH OF (ULTRA)FINE-GRAINED TETRAGONAL ZIRCONIC CERAMICS Ph.D. Thesis
Gerardus Stephanus A Theunissen 1991 207 p Sponsored by Ministry of Economic Affairs
(ISBN-90-9003972-4; ETN-92-92821) Avail: CASI HC A10/MF A03

A study to improve the bulk and interface properties of ceramic materials

based on tetragonal zirconia is presented. The preparation and compaction behavior of yttria doped zirconia powders is treated. The microstructure of the powders is compared with a commercially available powder. The microstructure development during sintering of Y-TZP is treated. The synthesized powders are very reactive resulting in fast densification at low temperatures. When employing isothermal sintering experiments it could be shown that a dense nanoscale ceramic is obtained (grain size less than 100 nm) after short sintering or sintering at very low temperature. Surface and grain boundary analysis on Y, Ce, and Ti doped zirconia ceramics are presented. This was done using AES (Auger Electron Spectroscopy) and XPS (X-ray Photoelectron Spectroscopy). Grain growth models are considered for grain growth control on ytteria doped zirconia ceramics. It is shown that the experimental observations point to grain growth control by means of an impurity drag mechanism. The influence of other dopants like cerium and titanium on the thermal and chemical stability of the tetragonal phase is presented, and experimental results in the compaction and sintering behavior of these powders are presented. The oxidation state of cerium in ceria doped zirconia ceramics and its influence on grain growth are investigated. ESA

N93-16484 Department of the Navy, Washington, DC.
POLYURETHANE SELF-PRIMING TOPCOATS Patent
Charles R. Hegedus, inventor (to Navy), Donald J. Hirst, inventor (to Navy), and Anthony T. Eng, inventor (to Navy) 23 Jun. 1992 6 p Filed 13 May 1991
(AD-D015477; US-Patent-5,124,385; US-Patent-Appl-SN-701406; US-Patent-Class-524-204) Avail: US Patent and Trademark Office

A corrosion-resistant coating which can be applied directly to a surface as a self-priming topcoat comprising from about 10 to 90 percent by weight of a polymeric polyurethane binder and 5 to 65 percent by weight of a combination of metal salts or pigments which consist essentially of calcium borosilicate, zinc salts of benzoic acids, and an alkaline earth metal phosphate such as zinc-barium phosphate. In addition, the coating may contain up to about 30 percent by weight of a titanium dioxide pigment and up to about 75 percent by weight of at least one organic solvent. GRA

N93-16487 Department of the Navy, Washington, DC.
NEW CLASS OF LUBRICANTS DERIVED FROM ARCHAEBACTERIAL LIPIDS Patent
Eddie L. Chang, inventor (to Navy) 24 Mar. 1992 6 p Filed 29 Nov. 1989
(AD-D015481; US-Patent-5,098,588; US-Patent-Appl-SN-442961) Avail: US Patent and Trademark Office

A new class of lubricants based on the general features of archaebacterial lipids but not limited to lipids solely extracted from archaebacteria is described. These lubricant/additive molecules have the following features: bipolarity, ether bonds and branched biphytanyl chains. They can be double chained or single chained. This new class has the potential to be highly thermally and chemically stable due to the above mentioned features. GRA

N93-16491# Technische Univ., Delft (Netherlands).
MORPHOLOGY, PROPERTIES, AND STABILITY OF THERMOPLASTIC POLYMER BLENDS Ph.D. Thesis
Hendrik Verhoogt 1992 156 p
(ETN-92-92791) Avail: CASI HC A08/MF A02

Morphology and stability of blends made of components with unusual rheological behavior such as certain thermoplastic elastomers and Liquid Crystalline Polymers (LCP's) were studied. Attention was focused on morphologies that are continuous because of the possible stability of this kind of morphology and morphologies that are fibrillar because of the tendency of LCP's to form fibers when blended with a thermoplast. The field of immiscible polymer blends is introduced. The terms miscibility and compatibility are discussed together with the variety of morphologies of polymer blends. The rheological properties of the polymers used are described. The theory of the breakup of polymer threads is described and the results of the breakup of several threads are presented. The influence of elasticity and yield stress in this breakup behavior is described. Results of the formation of blends with dual phase continuity on a two roll mill and the stability of the formed morphology during annealing and extrusion are given. The formation of self reinforced polymer blends consisting of an LCP and a styrene ethylene/butylene styrene thermoplastic elastomer is described. ESA

N93-16501# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.
DEVICE FOR APPLYING POWDER COATINGS
V. A. Belyy 15 Oct. 1992 6 p Transl. into ENGLISH of Russian Patent No. 276381, (14 Jul. 1970) p 1-2
(AD-A256917; FASTC-ID(RS)T-0410-92) Avail: CASI HC A02/MF A01

A device for the application of powder coatings is shown which is made in the form of a vertical chamber which is equipped with devices for feeding the parts to be coated into its upper section and the receiving of the coated parts in its lower section, and also for feeding the air-powder mixture inside the chamber. The device is also equipped with controllable electromagnets mounted on its walls. Drawings show the layout of the proposed device. E.R.

N93-16530# California Univ., Berkeley. Lawrence Berkeley Lab.
OPTICAL CHARACTERIZATION OF SPUTTERED CARBON FILMS
J. W. Ager, III May 1992 5 p Presented at the Institute of Electrical and Electronic Engineers Magnetic Recording Conference, Santa Clara, CA, 21-23 Jul. 1992
(Contract DE-AC03-76SF-00098)
(DE92-041209; LBL-32388; CONF-9207153-1) Avail: CASI HC A01/MF A01

Sputtered carbon films are widely used as protective overcoats for thin film disk media. Raman spectroscopy is nondestructive and relatively rapid and is well suited for the characterization of carbon films. Specific features in the Raman spectra are empirically correlated with the rates of specific types of mechanical wear for both hydrogenated and unhydrogenated films. This observation is interpreted in terms of a random covalent network, in which the mechanical performance of the film is determined by the nature of the bonding that links sp(sup 2) - bonded domains. DOE

N93-16545# Laval Univ. (Quebec).
STUDY OF HIGH ENERGY PARTICLES AND PROTECTIVE LAYERS FOR MATERIALS Final Report [ETUDE DE PARTICULES D'HAUTE ENERGIE ET DES COUCHES PROTECTRICES POUR MATERIAUX]
R. J. Slobodrian 18 Mar. 1988 70 p In FRENCH
(Contract DSS-31098-7-7-6024/01-SW)
(CTN-93-60613) Avail: CASI HC A04/MF A01

Two separate prototypes were designed for detecting solar and galactic cosmic rays on space stations. The former involves a combination of position sensitive silicon detectors with energy dissipators or ordinary silicon detectors. A nondestructive detection method based on induction of current by the azimuthal magnetic field created by an ion in movement was also explored. For galactic rays, a 30 by 30 by 9 cm detector comprising a Cerenkov radiator sandwiched between scintillation detectors was designed. A neutron detector based on Heidbreder et al (1970) is also proposed. The feasibility of deflecting charged particles away from a space station by electromagnetic shielding was studied by Monte Carlo simulation and classical relativistic dynamics and found to be feasible. Finally, experiments were conducted on the ion implantation and bombardment of Cr-coated iron. Five different doses of argon ions allowed measurement of the systematic behavior of ion implantation. After treatment, the tribologic properties of each sample were measured along with the resistance to corrosion in aqueous media. An optimum ion dose for improving the tribologic properties was determined, and it was observed that ion treatment enhanced corrosion resistance compared to samples not receiving treatment. CISTI

N93-16569# Technische Univ., Delft (Netherlands).
IMPACT ON CERAMIC FACED ARMOUR Ph.D. Thesis
Paulis Cornelis denReijer 1991 210 p Sponsored by National Technology Project 'Ballistische Arall' and TNO Defence Research
(ETN-92-92797) Avail: CASI HC A10/MF A03

A combination of theoretical and experimental work on ceramic faced armors is presented. The development of the penetration model ALARM (Analytic Lightweight Armor Response Model) is described. The results obtained with the model are compared with experimental data. The model's potential as an engineering tool is illustrated by examples of parameter studies. Experiments were conducted in order to improve the understanding

of the penetration process of projectiles into ceramic faced armors. They supplied information regarding projectile erosion, armor penetration and armor deformation throughout the impact event. The novel experimental technique used for these experiments, the test results and their analyses are described. The results of the experiments were used to evaluate and to validate the proposed description of the penetration process in the analytical model. ESA

N93-16570# Universiteit Twente, Enschede (Netherlands).
ELECTROCHEMICAL AND ELECTRODE PROPERTIES OF STABILIZED BISMUTH OXIDE CERAMICS Ph.D. Thesis
Izaak Cornelis Vinke 1991 173 p Sponsored by Netherlands Foundation for Chemical Research and Netherlands Organization for Applied Scientific Research
(ISBN-90-9003981-3; ETN-92-92822) Avail: CASI HC A08/MF A02

An experimental and theoretical study of some oxygen ion conducting materials, that are candidates for application in electrochemical devices, is presented. The oxygen transfer reaction was studied at the electrolyte surface of a solid solution of 75 pct. Bi2O3 and 25 pct. Er2O3 (BE25) using noble metal electrodes. It was concluded that the surface of BE25 is electrochemically active and that the noble metal electrode does not pay an important role other than having a function as current collector. Oxygen pumping experiments showed that rates of 180 ml/sq m.s at 900 K can be obtained in a sample of 1 mm thickness at a pumping potential of only 0.8 volt. Properties of some bismuth based mixed conductors were also studied: 75 pct. Bi2O3 25 pct. Tb4O7; bismuth vandate; Bi2O3 CeO2. These materials may be of interest for applications as electrode materials as they provide a large reaction surface. These materials may also be useful as semipermeable membranes in electrocatalytic and permeation reactors. For all of these applications it is essential to know the bulk properties of the mixed conducting ceramics. ESA

N93-16597# Oak Ridge National Lab., TN.
UNSOLVED PROBLEMS OF CRYSTALLIZATION AND MELTING OF FLEXIBLE MACROMOLECULES
B. Wunderlich 1992 12 p Presented at the NATO Workshop on Crystallization of Polymers, Mons, Belgium, 6-12 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040876; CONF-9209207-1) Avail: CASI HC A03/MF A01

The thermodynamics, kinetics, and computer simulations of crystallization and melting is discussed. The thermodynamics is shown to be well understood, although for many specific crystals not enough details for full description are available. Experiments on the crystallization kinetics of poly(ethylene) and poly(oxyethylene) in the presence of crystal nuclei as a function of molecular mass revealed that with increasing mass, the crystallization behavior deviates increasingly from that of small, rigid molecules. Instead of showing a continuously changing, linear crystallization rate with temperature through the equilibrium melting temperature, T(sub m)(sup 0), these flexible macromolecules show a region of practically zero crystallization rate between T(sub m)(sup 0) and about (T(sub m)(sup 0) - 15) K, creating a temperature region of metastability in the melt that cannot be broken by nucleation with pregrown crystals. Molecular Nucleation was proposed as a cooperative process to be of overriding importance for the description of polymer crystallization, and to be at the center of segregation of molecules of lower molecular mass by growing crystal fronts. Initial efforts to model sufficiently large crystals using Monte Carlo and molecular dynamics methods are presented. Some of the short-time intermediates in the melting, crystallization, and annealing processes seem to have little similarity to commonly assumed models of crystallization and melting and are presented as discussion topics. DOE

N93-16607# Technische Univ., Delft (Netherlands).
THE HYDROTHERMAL SYNTHESIS OF CERAMIC POWDERS Ph.D. Thesis
Pieter Krijgsman 1992 147 p
(ETN-92-92785) Copyright Avail: CASI HC A07/MF A02

The history of the hydrothermal synthesis is summarized and an appropriate definition of hydrothermal processing and its associated conditions is described. The chronological development of the present large scale process as it is now in operation in the factory in Sulitjelma (Norway) is described. The development of this production process covers both the mechanical and chemical engineering disciplines. The synthesis of xonotlite is considered. This focuses on the chemistry, the solubility characteristics and the thermodynamics of the appropriate raw materials. The effect of substitutions in the xonotlite lattice, and the batch production of xonotlite are highlighted and the chemical and physical properties of the materials concerned are discussed. The hydrothermal preparation of magnesium aluminum oxide as a precursor to be used for further processing, is discussed. The hydrothermal formation of barium titanate which is used in the microelectronic industry for disc and tubular capacitors is outlined. Concluding remarks with respect to the hydrothermal route with its inherent advantages over other production methods are given. The process however, is confined to the production of oxidic materials only due to the reaction medium used. The patent protection of the developed process is considered, and a theoretical appraisal of an insulated pipe support made of high density xonotlite, its advantages and inherent cost savings, is made. ESA

N93-16984# Minnesota Mining and Mfg. Co., Saint Paul. Corporate Research Labs.
DUAL CURE SOLVENTLESS COATING PROCESS
Oct. 1992 47 p
(Contract DE-AC04-88ID-12692)
(DE93-001352; DOE/ID-12692/3) Avail: CASI HC A03/MF A01

The objective of Phase 3 of 3M's contract with the U.S. DoE is to complete proof-of-principle testing in full-scale systems of the dual cure photocatalyst technology developed in earlier Phases of the program. The Phase 3 commercial applications to be demonstrated are aerospace topcoats, aerospace primers, and solventless manufacture of tape backings. Work has been initiated in all three applications. Significant progress has been made in improving the performance of the urethane/acrylate formulation being used for the aerospace topcoat application. Key improvements have been made in obtaining reliable coating cure and increasing reverse impact and gloss performance. A sub-contract has been initiated with Boeing Defense and Space Group to perform testing of candidate 3M topcoat formulations in accordance with various military and commercial specifications. Technical challenges are being encountered with the aerospace primer formulation. Efforts to date have focused on establishing a good baseline epoxy/acrylate formulation with reliable cure conditions. Work on the third demonstration application, development of solventless backing saturants for electrical tape backings, has progressed well. Since the start of the program, evaluation of various backing substrates has been completed, initial resin formulations developed and optimized, and preparation of samples of complete tape constructions using dual cure backings. DOE

N93-17032# Georgia Tech Research Inst., Atlanta.
MODELING OF FORCED FLOW/THERMAL GRADIENT CHEMICAL VAPOR INFILTRATION
T. L. Starr and A. W. Smith Sep. 1992 37 p Prepared for Oak Ridge National Lab., TN
(Contract DE-AC05-84OR-21400)
(DE93-001615; ORNL/Sub-85-55901/03) Avail: CASI HC A03/MF A01

The forced flow/thermal gradient chemical vapor infiltration process (FCVI) has proven to be a successful technique for fabrication of ceramic matrix composites. It is particularly attractive for thick components which cannot be fabricated using the conventional, isothermal method (ICVI). Although it offers processing times that are at least an order of magnitude shorter than ICVI, FCVI has not been used to fabricate parts of complex geometry and is perceived by some to be unsuitable for such components. The major concern is that selection and control of the flow pattern and thermal profile for optimum infiltration can be a difficult and costly exercise. In order to reduce this effort, a computer model is being developed for FCVI that simulates the densification process for given component geometry, reactor configuration and operating parameters. Used by a process engineer, this model can dramatically reduce the experimental effort needed to obtain uniform densification. A one-dimensional process model, described in a previous interim report, has demonstrated good agreement with experimental results in predicting overall densification time and density uniformity during processing and the effect of various fiber architectures and operating parameters on these process issues. This model is fundamentally unsuitable for more complex geometries, however, and extension to two- and three-dimensions is necessary. DOE

N93-17062*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SINTERING SILICON NITRIDE Patent Application
N. P. Bansal, inventor (to NASA), S. R. Levine, inventor (to NASA), and W. A. Sanders, inventor (to NASA) 27 Nov. 1992 7 p
(NASA-Case-LEW-15489-1; NAS 1.71:LEW-15489-1;
US-Patent-Appl-SN-982535) Avail: CASI HC A02/MF A01

Oxides having a composition of (Ba(1-x)Sr(x))O-Al2O3-2SiO2 are used as sintering aids for producing an improved silicon nitride ceramic material. The x must be greater than 0 to insure the formation of the stable monoclinic celsian glass phase. NASA

N93-17065# Oak Ridge National Lab., TN.
THE DESIGN AND PROPERTIES OF CERAMICS REINFORCED BY WHISKERS AND SIMILAR MICROSTRUCTURAL FEATURES
P. F. Becher, K. B. Alexander, C. H. Hsueh, H. T. Lin, T. N. Tiegs, and W. H. Warwick 1992 30 p Presented at the Advanced Workshop on Whiskers and Particles in Composite Materials Technology, Trieste, Italy, 5-9 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001372; CONF-9210182-1) Avail: CASI HC A03/MF A01

Whiskers impart considerable toughening and provide increased resistance to strength degradation during service due to thermal stresses, crack growth, and contact or impact damage. Whisker-reinforced ceramics also exhibit improvements in strength and toughness that are retained over a broad temperature range. Furthermore, reinforcements that resist deformation at elevated temperatures, e.g., SiC whiskers, result in substantial improvements in creep resistance of ceramics. However, successful design of toughened ceramics must consider the material properties and characteristics which control the toughening response and related mechanical properties. This paper reviews the design concepts for ceramics reinforced with discontinuous phases and the influence of such reinforcements on a variety of mechanical properties. DOE

N93-17173# Eltech Systems, Inc., Fairport Harbor, OH.
EVALUATION OF CERIUM OXIDE COATED Cu CERMETS AS INERT ANODES FOR ALUMINUM ELECTROWINNING
Aug. 1992 149 p
(Contract DE-FC07-90ID-12949)
(DE92-019333; DOE/ID-12949/T1) Avail: CASI HC A07/MF A02

Cu/NiFe2O4 cermets were evaluated, with and without an in-situ deposited CEROX (TM; cerium oxide) coating, in 100 h laboratory Al electrowinning tests. Bath ratio and current density were varied between tests and corrosion was determined by contamination of the aluminum and cryolite by cermet components (Cu, Fe, and Ni). Higher bath ratios of 1.5 to 1.6 led to less corrosion and thicker CEROX coatings. Lower current densities led to slightly less corrosion but much less oxidation of the Cu cermet substrate. At identical test conditions, the corrosion of the CEROX coated cermets was 1/7 that of an uncoated cermet. Corrosion was increased in CEROX coated cermets tested under unsaturated alumina conditions. The electrical conductivity of the CEROX coating was measured to be approximately 0.2 ohm(exp -1)cm(exp -1), resulting in a slight voltage penalty, depending on the thickness of the coating. DOE

N93-17229# Sandia National Labs., Albuquerque, NM.
MODELING OF THE VACUUM PLASMA SPRAY PROCESS
D. J. Varacalle, Jr. (Idaho National Engineering Lab., Idaho Falls.), R. A. Neiser, and M. F. Smith 1992 6 p Presented at the 1992 International Thermal Spray Conference, Orlando, FL, 1-5 Jun. 1992
(Contracts DE-AC04-76DP-00789; DE-AC07-76ID-01570)
(DE93-000718; SAND-92-1289C; CONF-9206135-8) Avail: CASI HC A02/MF A01

Experimental and analytical studies have been conducted to investigate gas, particle, and coating dynamics in the vacuum plasma spray (VPS) process for a tungsten powder. VPS coatings were examined metallographically and the results compared with the model's predictions. The plasma was numerically modeled from the cathode tip to the spray distance in the free plume for the experimental conditions of this study. This information was then used as boundary conditions to solve the particle dynamics. The predicted temperature and velocity of the powder particles at standoff were then used as initial conditions for a coating dynamics code. The code predicts the coating morphology for the specific process parameters. The predicted characteristics exhibit good correlation with the observed coating properties. DOE

N93-17349# Ames Lab., IA.
SPIN DEPENDENT RECOMBINATION IN CONJUGATED POLYMERS: AN OPTICALLY DETECTED MAGNETIC RESONANCE STUDY Ph.D. Thesis
L. S. Swanson Sep. 1992 126 p
(Contract W-7405-eng-82)
(DE93-001221; IS-T-1585) Avail: CASI HC A07/MF A02

Photoluminescence (PL), and X-band Photoluminescence Detected Magnetic Resonance (PLDMR) of poly(3-alkylthiophene) (P3AT) films and solutions, poly(para-phenylenevinylene) (PPV), poly(2,5 dihexoxypara-phenylenevinylene) (PDHOPV), poly(2,5 dioctoxyparaphenylenevinylene) (PDOOPV), blends of poly(2-methoxy,5-(2'ethylhexoxy) paraphenylenevinylene) (PMOEHOPV) with polyethylene (PE) films both unoriented and oriented, and poly(2,5-dibutoxy paraphenyleneacetylene) (PDBOPA) films are described and discussed. The Electroluminescence Detected Magnetic Resonance (ELDMR) and Conductivity Detected Magnetic Resonance (CDMR) narrow quenching signal in PPV is also reported and discussed. DOE

N93-17463# Oak Ridge National Lab., TN.
STATUS AND COVARIANCE FILES OF THE SCATTERING MATRIX OF GRAPHITE
F. C. Difilippo, J. P. Renier, and B. A. Worley 1992 7 p Presented at the Symposium on Nuclear Data Evaluation Methodology, Upton, NY, 12-16 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001632; CONF-921046-5) Avail: CASI HC A02/MF A01

Calculations related to the temperature coefficient of reactivity of enriched gas-cooled reactors show the high sensitivity of this parameter to the proper description of thermalization effects in the moderator; additionally, calculation of the temperature dependence of the inelastic scattering cross section correlates the errors of the cross sections as functions of the temperature. The ENDF/B evaluation of S(alpha, beta, T) is still based on the approximations (incoherent component only) and phonon spectras of the early 60's. Subsequent measurements showed that the structure observed in S(alpha, beta, T) cannot be described using the incoherent approximation, and soon after the availability of highly intense neutron beams and large specimens of pyrolitic graphite better calculation of the phonon spectra were possible. Our calculations of the probability distributions of the momentum and energy transfer, alpha and beta, allow one to define a range of alpha and beta for which comparison of experimental and theoretical data is of most interest for reactor analysis and to point out regions of deficient resolution or excessive details in the present alpha, beta mesh used in the ENDF/B files. Because the phonon spectra defines S(alpha, beta, T), we have found mathematical formulas that allow the calculation of the covariance matrix of S by propagating the errors of the phonon spectra. DOE

N93-17467# Ames Lab., IA.
CHARACTERIZATION OF SELF-ASSEMBLED CARBOXYLATE MONOLAYERS AND MULTILAYERS AT COPPER AND SILVER Ph.D. Thesis
E. L. Smith Oct. 1992 148 p
(Contract W-7405-eng-82)
(DE93-002526; IS-T-1134) Avail: CASI HC A07/MF A02

A variety of chemically modified surfaces were constructed by the self-assembly method via chemisorption onto evaporated metal films. Monolayer films, self-assembled from solution, include n-alkanoic acids, CH3(CH2)(n)COOH, and n-perfluoroalkanoic acids, CF3(CF2)(n)COOH, on copper, and n-alkanethiolates, CH3(CH2)(n) SH on copper. Monolayer films were obtained from the gas phase, a newly developed technique, for n-alkanoic acids on silver, and n-alkanethiolates on silver and gold. Multilayer films obtained by self-assembly from the gas phase include n-alkanoic acids at copper and silver and perfluoroacids at copper. Carboxylic acid terminated interfaces were formed by the self-assembly of the bifunctional mercaptoacids, HS(CH2)(n)COOH, via the thiol moiety, at gold. These interfaces were derivatized with copper by deposition of a thin metal overlayer. The monolayer and multilayer films were characterized by optical ellipsometry, contact angle measurements, atomic force and scanning

tunneling microscopies, and infrared reflection spectroscopy. Comparisons were made to properties of analogous bulk compounds. These techniques were used to determine the properties of these films such as composition, orientation, defectiveness, molecular ordering and environment, and hydrophobicity and reactivity. DOE

N93-17472# Japan Atomic Energy Research Inst., Tokyo.
HIGH HEAT FLUX EXPERIMENT ON B4C-OVERLAID C/C COMPOSITES FOR PLASMA FACING MATERIALS OF JT-60U
Kazuyuki Nakamura, Masato Akiba, and Satoshi Suzuki (Japan Atomic Energy Research Inst., Naka.) Apr. 1992 48 p
(DE93-715315; JAERI-M-92-052) Avail: CASI HC A03/MF A01

In JT-60U, B4C-overlaid C/C composites are under investigation for the divertor tile application. The tiles will be exposed to severe heat loads, which are estimated to be around 10 MW/m(exp 2) for 5s in case of normal plasma operation and 2-3 MJ/m(exp 2) in case of plasma disruption. Surface damages of B4C-overlaid C/C composites were investigated. High heat flux irradiation experiments using the JAERI electron beam irradiation stand (JEBIS) were carried out on three kinds of B4C-overlaid C/C composites. The three methods of overlaying B4C with thickness of 100-250 microns on C/C composites are the conversion method, the chemical vapor deposition (CVD) method, and the low pressure plasma spray (LPPS) method. Irradiations were performed under the normal (5-40 MW/m(exp 2), 5s) and disruption (550 MW/m(exp 2), 5-10 ms) conditions. Measurements were made with respect to the weight loss, changes of the surface morphology and of the surface atomic composition, and the surface temperature. As a result of these experiments, it turned out that the conversion method is superior to others with regard to the surface damages under the present heat flux conditions. DOE

N93-17486# Lawrence Livermore National Lab., CA.
LOW-DENSITY FOAM MATERIALS FROM STYRENE-DIVINYLBENZENE INVERSE EMULSIONS
R. C. Cook, G. E. Overturf, III, B. L. Haendler, Fung-Ming Kong, and S. A. Letts Jul. 1992 15 p
(Contract W-7405-eng-48)
(DE93-002854; UCRL-LR-109207) Avail: CASI HC A03/MF A01

This report documents the research and development work conducted by the Materials Research and Production Group of the LLNL ICF Program's Special Projects Group between 1985 and 1989. A foam material composed of heavily cross linked polystyrene-divinylbenzene was prepared from an inverse emulsion of the monomers in water. Final foam densities as low as 25 mg/cc were obtained; cell sizes were not greater than 2 to 3 microns. This report documents procedures and characterization of the final material. DOE

N93-17498# Oak Ridge National Lab., TN.
ION BEAM APPLICATION FOR IMPROVED POLYMER SURFACE PROPERTIES
E. H. Lee, G. R. Rao, M. B. Lewis, and L. K. Mansur 1992 13 p Presented at the 9th International Conference on Ion Implantation Technology, Gainesville, FL, 21-24 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001375; CONF-9209245-1) Avail: CASI HC A03/MF A01

Various polymeric materials were subjected to bombardment by different energetic ions with energies ranging from 200 to 1000 keV. Tests showed substantial improvements in hardness, wear resistance, oxidation resistance, resistance to chemicals, and electrical conductivity. The magnitude of property changes was strongly dependent upon ion species, energy, dose, and polymer structure. Both hardness and electrical conductivity increased with ion energy and dose. These properties were apparently related to the effectiveness of cross-linking. Ion species with a large electronic stopping cross-section are expected to produce more crosslinking. It is believed that the polymer property improvements are commensurate with the extent of crosslinking, which is responsible for the formation of three-dimensionally-connected, carbon-rich, rigid networks. DOE

N93-17529# Tennessee Univ., Knoxville.
POLYMER-BASED SEPARATIONS: SYNTHESIS AND APPLICATION OF POLYMERS FOR IONIC AND MOLECULAR RECOGNITION
S. D. Alexandratos Jan. 1992 20 p
(Contract DE-FG05-86ER-13591)
(DE93-001835; DOE/ER-13591/6) Avail: CASI HC A03/MF A01

Polymer-based separations have utilized resins such as sulfonic, acrylic, and iminodiacetic acid resins and the XAD series. Selective polymeric reagents for reaction with a targeted metal ion were synthesized as polymers with two different types of functional groups, each operating on the ions through a different mechanism. There are 3 classes of DMBP's (dual mechanism bifunctional polymers). Research during this period dealing with metal ion recognition focused on two of these classes (reduction of metal ions to metal and selective complexation). DOE

N93-17643# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
OPTIMAL AR-COATING FOR OPTICAL WAVEGUIDE DEVICES
W. Hellmich and Peter P. Deimel 1990 9 p Repr. from Journal of Lightwave Technology, v. 10, no. 4, Apr. 1992 p 469-476 Previously announced in IAA as A92-40260
(MBB-Z-0348-90-PUB; ETN-92-92745) Avail: CASI HC A02/MF A01

The optimal index of refraction and thickness of an Antireflection (AR) coating layer for optical modes (TE/TM) in semiconductor laser devices was calculated. Various correction factors concerning the two dimensional carrier gas were taken into account: the change in photonic energy depending on the width of the quantum well, the resulting change in refractive indexes, and the change in effective masses of the carriers. The effective optical model index is compared to the exact calculated value for the optimal coating index. ESA

N93-17657# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
MOLECULAR AND POLYMERIC CERAMIC PRECURSORS
L. G. Sneddon Jun. 1992 8 p
(Contract DE-FG02-87ER-13732)
(DE93-002841; DOE/ER-13732/6) Avail: CASI HC A02/MF A01

The development of new methods for the production of complex materials is one of the most important problems in modern solid state chemistry and materials science. This project is attempting to apply the synthetic principles which have evolved in inorganic and organometallic chemistry to the production of technologically important non-oxide ceramics, such as boron nitride, boron carbide, and metal borides. Recent work has now resulted in the production of new polymer systems, including poly(B-vinylborazine), polyvinylpentaborane, and polyborazylene, that have proven to be high yield precursors to boron-based ceramic materials. Current work is now directed toward the synthesis of new types of molecular and polymeric boron-containing species and an exploration of the solid state properties of the ceramics that have been produced in these studies. DOE

N93-17676# Naval Postgraduate School, Monterey, CA.
X RAY DIFFRACTION AND ELECTRON MICROSCOPE STUDIES OF YTTRIA STABILIZED ZIRCONIA (YSZ) CERAMIC COATINGS EXPOSED TO VANADIA M.S. Thesis
Kostandinos G. Kondos Sep. 1992 52 p
(AD-A258055) Avail: CASI HC A04/MF A01

The U.S. Navy sometimes has the requirement to use low cost fuels containing significant amounts of vanadium and sulfur in gas turbine engines. Unfortunately the yttria stabilized zirconia (YSZ) which is used as a thermal barrier coating on gas turbine blades can be severely attacked by vanadia. Powders of YSZ containing 8-mol percent Y2O3 and pure zirconia containing various and mounts Of V2O5 were annealed at 900 C. These were then examined by x-ray diffraction and electron microscopy, as well as single crystals of pure Zro2 and YSZ (20 wt percent Y2O3) exposed to V2O5 melts, to study how the vanadia degrades the YSZ by reacting with the stabilizer to form YVO4 and how the vanadium transforms the cubic and tetragonal YSZ crystal structures to monoclinic which degrades rapidly as a gas turbine blade coating. GRA

N93-17700# Paderborn Univ. (Germany).
INTERNATIONAL CONFERENCE ON DEFECTS IN INSULATING MATERIALS
22 Aug. 1992 456 p Conference held in Nordkirchen, Germany, 16-21 Aug. 1992
(Contract DAJA45-92-M-0280)
(AD-A258004) Avail: CASI HC A20/MF A04

The 1992 International Conference on Defects in Insulating Materials,

held in the historical palace of Nordkirchen in Germany, continues a series of successful international conferences. The series developed from a conference on color centers in alkali halides (1956) into the International Conference on Defects in Insulating Crystals (ICDIC), 1988 held in Italy. The conference series is merged with the Europhysical Topical Conference on Lattice Defects in Ionic Materials (LATDIM), creating a biannual series of international conferences on this topic. As seen from this year's conference title, the emphasis has proceeded further towards materials science and consequently the conference is now called International Conference on Defects in Insulating Materials (ICDIM). The aim is to provide a forum to bring together scientists from academic research and industry to discuss both the basic physics of defects in a wide range of insulating materials and their role in numerous applications, a rapidly expanding field. GRA

N93-17807# Imagination Resources, Inc., Dublin, OH.
COMPATIBILITY OF REFRIGERANTS AND LUBRICANTS WITH ENGINEERING PLASTICS
R. C. Cavestri Jul. 1992 25 p
(Contract DE-FG02-91CE-23810)
(DE93-000541; DOE/CE-23810/3F) Avail: CASI HC A03/MF A01

All seven oil immersion studies are complete at both temperatures. Nine out of ten refrigerant ambient immersion studies are complete including 60 C for R-123. All 22 plastic test materials have been molded into test bars. All test bars have been quality controlled for physical consistency and integrity. All 22 test chambers are functional. Creep loads have been increased to 25 percent of ultimate tensile. Refrigerant has solubilities of Emery 2927 with R-22 and 134a are complete. DOE

N93-16764*# Hampton Univ., VA. Dept. of Chemistry.
UNDERSTANDING CRYSTALLINITY IN AROMATIC POLYIMIDES
Edward A. Celarier *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 87-90 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16766*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PHYSICAL AGING AND SOLVENT EFFECTS ON THE FRACTURE OF LARC-TPI ADHESIVES
David A. Dillard (Virginia Polytechnic Inst. and State Univ., Blacksburg.), Terry L. St.Clair, and W. Steven Johnson *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 93-96 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16794*# Hampton Univ., VA. Dept. of Chemistry.
CHARACTERIZATION OF RADIATION-INDUCED DAMAGE IN HIGH PERFORMANCE POLYMERS BY ELECTRON PARAMAGNETIC RESONANCE IMAGING SPECTROSCOPY
Naushadalli K. Suleman *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 185-186 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16904*# Portland Cement Association, Skokie, IL.
PROPERTIES AND USES OF CONCRETE, APPENDIX B
Gene Corley *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 312-316 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

N93-17288*# Spelman Coll., Atlanta, GA. Dept. of Chemistry.
PREDICTION OF NONLINEAR OPTICAL PROPERTIES OF LARGE ORGANIC MOLECULES
Beatriz H. Cardelino *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17302*# Auburn Univ., AL. Dept. of Mechanical Engineering.
SPACE ENVIRONMENTAL EFFECTS ON POLYMERS AND COMPOSITES
Bor Z. Jang *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17333*# Tuskegee Inst., AL. Dept. of Chemical Engineering.
THERMOSTRUCTURAL RESPONSES OF CARBON PHENOLICS IN A RESTRAINED THERMAL GROWTH TEST
C. Jeff Wang *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N93-15686# Naval Postgraduate School, Monterey, CA.
ATOMIZATION OF JP-10/B4C GELLED SLURRY FUEL M.S. Thesis
John D. Guglielmi Jun. 1992 49 p
(AD-A256827) Avail: CASI HC A03/MF A01

The atomization of a gelled boron slurry fuel using two commercially available airblast atomizers was studied at atmospheric pressure in non-reacting flow. The atomization of water was also characterized for comparison. Each atomizer was operated at two different liquid mass flow rates and several air/fuel ratios. Drop size distribution was measured using a Malvern 2600 HSD Laser Diffraction Particle Sizer. Drop sizes acceptable for use in ramjet combustors could be obtained for the gelled slurry fuel from both atomizers. However, this required air/fuel ratios too high for practical applications. It appears that secondary atomization methods or different types of atomizers will be required to obtain high ramjet combustion efficiencies with these fuels if they are to be used over typical ramjet operating envelopes. Author (GRA)

N93-15708# Naval Surface Warfare Center, Silver Spring, MD.
EFFECTS OF PARTICLE BEAMS ON EXPLOSIVES Final Report
J. Sharma and B. C. Beard Dec. 1991 25 p
(AD-A256878; NAVSWC-TR-91-682) Avail: CASI HC A03/MF A01

For application of particle beams as weapons, it is essential to know the consequences of beam-explosives interactions. In the present work, explosives have been subjected to particle beams of varied parameters below the level of ignition and the consequent chemical and physical changes have been determined. It has been found that in primary explosives (lead azide and lead styphnate) thermal ignition can be achieved regardless of confinement. However, in the case of high explosives such as TNT, HMX, and TATB, confinement is required for thermal ignition. Without confinement other changes such as crystal phase transitions, melt-flow, evaporation, spallation, pyrolysis, fragmentation and chemical decomposition occur. These phenomena could conceivably disable a warhead indirectly by adversely effecting the performance of its explosives. GRA

N93-15932 Johns Hopkins Univ., Columbia, MD. Chemical Propulsion Information Agency.
DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD EXPLOSIVES SAFETY SEMINAR ABSTRACTS (1959-1990) Abstracts Only
C. L. Cameron, ed. Nov. 1991 453 p Seminars held 1 Jan. 1959 - 31 Dec. 1990; sponsored by Joint NASA, Army, Navy, Air Force Interagency Propulsion Committee
(Contract N00014-91-C-0001)
(AD-A250032; CPIA-Publ-577) Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

Informative abstracts and indexes are presented for the papers presented at the Department of Defense Explosives Safety Board (DDESB) Safety

Seminars. This volume covers Seminars 1-24 covering the period from 1959 to 1990. The volume contains citations for 1492 papers, and the data have been added to the computer-searchable data base of the Chemical Propulsion Information Agency. A fall bibliographic citation is given for each of the papers, including indications of document availability. Subject, corporate source, personal author, abstract number to DTIC number, DTIC number cross-reference, and contract number indexes are included. GRA

N93-16003# University of Southern California, Los Angeles. Dept. of Contracts and Grants.

SYNTHESIS OF NEW ENERGETIC MATERIALS Final Technical Report, 1989 - 1992

1992 3 p

(Contract N00014-89-J-3189)

(AD-A257200) Avail: CASI HC A01/MF A01

A convenient one-step preparation of hydrazinium nitrates by the reaction of tertiary amines or azaarenes with hydroxylamine-O-sulfonic acid and barium nitrate in the barium oxide was developed. The hydrazinium nitrates were easily transformed into amine-nitroimides with trifluoroacetic anhydride-trifluoroacetic acid using Katritzky's procedure including bridgehead nitrogen systems. Remarkably stable, high energetic compounds such as DABCO-1,4-bis-nitroimide (1) were obtained in good preparative yield. Detailed spectroscopic and x ray structural studies were carried out to substantiate the structures. In preliminary tests, compound 1 was found to be of high energetic nature with density 1.610 g/cc. GRA

N93-16051# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.

STUDY OF DYNAMIC BEHAVIOR AND HAZARDS OF VHBR, LOVA, AND PSS PROPELLANTS UNDER RAPID IGNITION AND COMBUSTION CONDITIONS BY REAL-TIME X RAY RADIOGRAPHY Final Report

K. K. Kuo, W. H. Hsieh, and S. J. Ritchie 9 Dec. 1991 166 p

(Contract DAAL03-87-K-0064)

(AD-A256775; ARO-25121.9-EG) Avail: CASI HC A08/MF A02

The purpose of this work is to study the dynamic behavior in the combustion of three types of propellants used in artillery systems. These propellants include very high burning rate (VHBR), low vulnerability ammunition (LOVA), and programmed splitting stick (PSS) propellants. Several advanced nonintrusive diagnostic instruments were utilized in this study. These instruments include: a real-time x-ray radiography system, a digital image processing system, a multi-channel laser Doppler velocimeter, and high-speed movie cameras. A shock tunnel and a high-powered CO2 laser were also employed for this investigation. This research project was divided into three major areas: (1) combustion behavior of VHBR propellants; (2) convective and radiative ignition processes of LOVA propellants; and (3) combustion and segregation phenomena of PSS propellants. The research motivation, program objectives, method of approach, results, and summary and conclusions of each are given in Chapters 1, 2, and 3 respectively. Results obtained from this study not only enhance the basic understanding of the complex phenomena and controlling mechanisms associated with ignition, combustion, and mechanical deformation of these propellants but also helps the design of future artillery systems with minimum hazards. GRA

N93-16384*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

EXPERIMENTS ON A ROUND TURBULENT BUOYANT PLUME

Aamir Shabbir and William K. George (State Univ. of New York, Buffalo.) Dec. 1992 70 p

(Grants NSF ATM-80-23699; NSF MSM-83-16833; RTOP 505-62-21)

(NASA-TM-105955; ICOMP-92-25; E-7475; NAS 1.15:105955; CMOTT-92-13) Avail: CASI HC A04/MF A01

This paper reports a comprehensive set of hot-wire measurements of a round buoyant plume which was generated by forcing a jet of hot air vertically up into quiescent environment. The boundary conditions of the experiment were measured, and are documented in the present paper in an attempt to sort out the contradictory mean flow results from the earlier studies. The ambient temperature was monitored to insure that the facility was not stratified and that the experiment was conducted in a neutral environment. The axisymmetry of the flow was checked by using a planar array of sixteen thermocouples and the mean temperature measurements from these are used to supplement the hot-wire measurements. The source flow conditions were measured so as to ascertain the rate at which the buoyancy was added to the flow. The measurements conserve buoyancy within 10 percent. The results are used to carry out the balances of the mean energy and momentum differential equations. In the mean energy equation it is found that the vertical advection of the energy is primarily balanced by the radial turbulent transport. In the mean momentum equation the vertical advection of momentum and the buoyancy force balance the radial turbulent transport. The buoyancy force is the second largest term in this balance and is responsible for the wider (and higher) velocity profiles in plumes as compared to jets. Budgets of the temperature variance and turbulence kinetic energy are also carried out in which thermal and mechanical dissipation rates are obtained as the closing terms. Similarities and differences between the two balances are discussed. It is found that even though the direct affect of buoyancy on turbulence, as evidenced by the buoyancy production term, is substantial, most of the turbulence is produced by shear. This is in contrast to the mean velocity field where the affect of buoyancy force is quite strong. Therefore, it is concluded that in a buoyant plume the primary affect of buoyancy on turbulence is indirect, and enters through the mean velocity field (giving larger shear production). Author

N93-16431# Southwest Research Inst., San Antonio, TX. Belvoir Fuels and Lubricants Research Facility.

FIELD DEMONSTRATION OF AVIATION TURBINE FUEL MIL-T-83133C, GRADE JP-8 (NATO CODE F-34), AT FORT BLISS, TX Interim Report, 1 Aug. 1990 - 30 Sep. 1991

Walter E. Butler, Jr., Ruben A. Alvarez, Douglas M. Yost, Steven R. Westbrook, and Janet P. Buckingham Sep. 1992 80 p

(Contract DAAK70-87-C-0043; DA Proj. 1L2-63001-D-150)

(AD-A256945; BFLRF-278) Avail: CASI HC A05/MF A01

A field demonstration was conducted at Ft. Bliss, TX, to determine the feasibility of using JP-8 fuel (MIL-T-83133C, NATO Code F-34) in U.S. Army ground combat/tactical vehicles and equipment (V/E) in lieu of DF-2 diesel fuel. The demonstration was conducted during the period 1 February 1989 through 30 September 1991. The results of the demonstration for the period 1 February 1989 through 31 July 1990 were reported in Interim Report BFLRF No. 264. After 31 July 1990, Operation Desert Shield/Storm resulted in the deployment to the Middle East of over 2,000 of the initial 2,800 plus V/E participating in the demonstration at Ft. Bliss, leaving approx. 750 V/E for the remaining demonstration interval through 30 September 1991. There was no significant return of V/E to Ft. Bliss by the end of the program. However, by that time, it was apparent that initial results reported in Interim Report BFLRF No. 264 were verified during the remainder of the demonstration. GRA

N93-17459# Argonne National Lab., IL.

RECENT RESEARCH EFFORTS IN THE AREA OF BIOTECHNOLOGY FOR FUELS AND CHEMICALS: POSTER SESSION PAPERS

A. A. Antonopoulos and K. Grohmann (US Citrus and Subtropical Products Lab., Winter Haven, FL.) 1992 10 p Presented at the 14th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, 11-15 May 1992

(Contract W-31-109-eng-38)

(DE92-041130; ANL/CP-77167; CONF-920508-5) Avail: CASI HC A02/MF A01

This report presents research presented at the poster session of the Symposium covering a wide spectrum of current biotechnological research activities. Research focused mostly on ethanol production and methane generation from biomass material via microbial processing, as well as on enhanced hydrogen yield from algae. Several of the posters dealt with the pretreatment of cellulosic materials, and enzyme production/characterization, while a good number of papers displayed research efforts on bioremediation, photosynthesis, production of various useful chemicals from biomass by bioprocessing, and on other miscellaneous subjects. One of the papers treated a very interesting topic of cellulose-cellulase complexes. Many of the poster papers are included in this volume, and a synopsis of all the poster/papers presented is the subject of this article. DOE

N93-17751# Weizmann Inst. of Science, Rehovoth (Israel).

THE 4TH INTERNATIONAL SYMPOSIUM ON ANALYSIS AND DETECTION OF EXPLOSIVES: PROGRAMS AND ABSTRACTS

10 Sep. 1992 70 p Symposium held in Jerusalem, Israel, 7-10 Sep.

1992
(Contract DAJA45-92-M-0117)
(AD-A258029; R/D-6855-CH-02) Avail: CASI HC A04/MF A01

Abstracts of the papers presented at the 4th International Symposium on Analysis and Development of Explosives are presented. Technical sessions addressed basic analytic techniques, analysis of explosive residues, analysis of Semtex, analysis of gunshot residues, detection of explosives, fragmentation processes in energetic materials, mass spectrometry, and vapor generators. M.G.

N93-17795*# Wickman Spacecraft and Propulsion Co., Citrus Heights, CA.
LIQUID OXYGEN/METAL GELLED MONOPROPELLANTS Final Report
John H. Wickman Nov. 1991 90 p
(Contract NAS3-26056)
(NASA-CR-187193; NAS 1.26:187193) Avail: CASI HC A05/MF A01

The objectives of this program were to establish the feasibility of metallized/liquid oxygen monopropellants and select the best monopropellant formulation for continued study. The metal powders mixed with the liquid oxygen were aluminum/magnesium (80/20), silicon and iron (Iron was only tested for burning properties). The formulations were first evaluated on whether they detonated when ignited or burned. The formulations only burned when ignited. The viscosity for the formulations ranged from 900 cps to 100 cps at shear rates up to 300 seconds(sup -1). Two percent (by weight) of Cab-O-Sil was added to the aluminum and aluminum/magnesium formulations for gelling while the silicon formulation used three percent. Within a seven hour period, settling was suggested only in the 29 percent aluminum and 29 percent aluminum/magnesium formulations. The monopropellants were burned in a cylinder submerged in a liquid nitrogen bath. Experimental data at ambient pressure indicated that the monopropellants were extinguished when the flame front reached regions submerged under the liquid nitrogen. The burn rate increased dramatically when burned in a cylinder enclosure with less heat sink available to the monopropellant. The test results were inconclusive as to whether the increased burn rate was due to the lower heat sink capacity or the small amount of pressure (2 psi) generated during the burning of the monopropellant. The burning of the aluminum and aluminum/magnesium resulted in a brilliant white flame similar to that of an arc welder. These monopropellants burned in a pulsating manner with the aluminum/magnesium appearing to have less pulsating combustion. The silicon monopropellant burned with an orange glow. No sparks or energetic burning was apparent as with the aluminum or aluminum/magnesium. Author

N93-17799*# Science Applications International Corp., Schaumburg, IL. Advanced Planning and Analysis Div.
IN SITU PROPELLANT PRODUCTION: ALTERNATIVES FOR MARS EXPLORATION
Michael L. Stancati, Mark K. Jacobs, Kevin J. Cole, and John T. Collins Oct. 1991 125 p
(Contract NAS3-25809)
(NASA-CR-192213; NAS 1.26:192213; SAIC-91/1052) Avail: CASI HC A06/MF A02

Current planning for the Space Exploration Initiative (SEI) recognizes the need for extraterrestrial resources to sustain long-term human presence and to attain some degree of self-sufficiency. As a practical matter, reducing the need to carry large supplies of propellant from Earth will make space exploration more economical. For nearly every round trip planned with conventional propulsion, the actual payload is only a small fraction - perhaps 10-15 percent - of the mass launched from Earth. The objective of this study was to analyze the potential application for SEI missions of propellants made exclusively from lunar or martian resources. Using such propellants could minimize or eliminate the cost of carrying propellant for surface excursion vehicles and return transfers through two high-energy maneuvers: Earth launch and trans-Mars injection. Certain chemical mono- and bipropellants are candidates for this approach; they could be recovered entirely from in situ resources on the Moon and Mars, without requiring a continuing Earth-based resupply of propellant constituents (e.g., fuel to mix with a locally obtained oxidizer) and, perhaps, with minimal need to resupply consumables (e.g., reagents or catalyst for process reactions). A complete assessment of the performance potential of these propellants must include the requirements for installation, operations, maintenance, and resupply of the chemical processing facility. Author

N93-17612# Centre de Recherches du Bouchet, Vert de Petit (France). SNPE, Defense/Espace.
SEMI-PROPELLANTS FOR DUCTED ROCKETS [SEMI-PROPERGOLS POUR STATOFUSEE]
B Mahe, C. Perut, C. Vigot (Centre d'Etudes et de Recherches, Toulon, France), and C. Masson (Centre d'Etudes et de Recherches, Toulon, France) *In* AGARD, Airbreathing Propulsion for Missiles andProjectiles Sep. 1992 17 p In FRENCH (For primary document see N93-17607 05-20)
Copyright Avail: CASI HC A03/MF A03

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N93-15689*# Alabama Cryogenic Engineering, Inc., Huntsville.
ADIABATIC DEMAGNETIZATION REFRIGERATOR FOR USE IN ZERO GRAVITY Final Report, 28 Feb. 1986 - 11 Apr. 1988
Michael L. Dingus 16 Jun. 1988 143 p
(Contract NAS5-29418)
(NASA-CR-190864; NAS 1.26:190864) Avail: CASI HC A07/MF A02

In this effort, a new design concept for an adiabatic demagnetization refrigerator (ADR) that is capable of operation in zero gravity has been developed. The design uses a vortex precooler to lower the initial temperature of magnetic salt from the initial space superfluid helium dewar of 1.8 K to 1.1 K. This reduces the required maximum magnetic field from 4 Tesla to 2 Tesla. The laboratory prototype vortex precooler reached a minimum temperature of 0.78 K, and had a cooling power of 1 mW at 1.1 K. A study was conducted to determine the dependence of vortex cooler performance on system element configuration. A superfluid filled capillary heat switch was used in the design. The laboratory prototype ADR reached a minimum temperature of 0.107 K, and maintained temperatures below 0.125 K for 90 minutes. Demagnetization was carried out from a maximum field of 2 T. A soft iron shield was developed that reduced the radial central field to 1 gauss at 0.25 meters. Author

N93-16377# California Univ., Berkeley. Lawrence Berkeley Lab.
ON CANONICAL CYLINDER SECTIONS FOR ACCURATE DETERMINATION OF CONTACT ANGLE IN MICROGRAVITY
P. Concus, F. Zabihi, and R. Finn (Stanford Univ., CA.) Jul. 1992 8 p Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers, Anaheim, CA, 8-13 Nov. 1992
(Contract DE-AC03-76SF-00098)
(DE93-000635; LBL-32279; CONF-921110-29) Avail: CASI HC A02/MF A01

Large shifts of liquid arising from small changes in certain container shapes in zero gravity can be used as a basis for accurately determining contact angle. 'Canonical' geometries for this purpose, recently developed mathematically, are investigated here computationally. It is found that the desired 'nearly-discontinuous' behavior can be obtained and that the shifts of liquid have sufficient volume to be readily observed. DOE

N93-16426# Laval Univ. (Quebec). Dept. of Physics.
STUDY OF PRECISION ACCELEROMETERS AND FRACTAL AGGREGATES IN MICROGRAVITY, PHASE 2 Final Report [ETUDE D'ACCELEROMETRES DE PRECISION ET DES AGREGATS FRACTALS EN MICROGRAVITE, PHASE 2]
R. J. Slobodrian 26 Mar. 1991 71 p In FRENCH
(Contract DSS-31016-0-6016/01-SW)
(CTN-93-60616) Avail: CASI HC A04/MF A01

A precision accelerometer for microgravity experimentation is being developed to meet the objective of measuring accelerations from 10(exp -7) gravity up to 0.1 gravity, with a frequency response range from 100 Hz down to 10(exp -6) Hz. Calculations were performed for a design based on measuring the position of a ferromagnetic rod suspended within a solenoid. The results show that such an instrument should be able to meet the measurement objectives stated above. In addition, by modifying the current in the solenoid, the springlike constant of the system can be modified to match the force applied to the apparatus. A prototype instrument

is to be constructed using a simple optical system for position measurement. In fractal aggregate research, an evaporation condensation method was developed for producing metallic fractal aggregates in Ar and Kr atmospheres. Aggregates were also produced by chemical reaction and by flotation of fine powders. The aggregates were studied by optical and electron microscopy and high quality images were obtained by a high-resolution charge coupled device camera. Dimensional analysis verified that the aggregates are fractals, but their size is under 1 mm. A reduced gravity environment would yield macroscopic aggregates, and the experiments performed are readily adaptable to microgravity experimentation CISTI

N93-16427# Queens Univ., Kingston (Ontario). Dept. of Metallurgical Engineering.

THE INFLUENCE OF MICROGRAVITY ON THE MICROSTRUCTURE AND PROPERTIES OF EUTECTICS, PHASE 2 Final Report

Reginald W. Smith 1991 85 p

(Contract DSS-31098-8-6034/01-SW)

(CTN-93-60627) Avail: CASI HC A05/MF A01

Intermetallic MnBi is of theoretical and practical interest because of its magnetic and magneto-optic properties. However, it is difficult to prepare pure polycrystalline specimens or large single crystals. The equilibrium phases and their crystallographic structure of the Mn-Bi system are reviewed along with their magnetic properties and potential methods for improving these properties. Experiments were conducted using eutectic (0.72 percent Mn) Bi/MnBi alloys which are directionally solidified. The effect of direction of solidification and growth rate on the morphology of the particles (rods) and on the rod diameter and the interrod spacing were determined. Samples were studied by optical microscopy, differential scanning calorimetry, x-ray diffraction, and transmission electron microscopy. It was seen that the morphology of the MnBi phase changed from irregular platelike to broken fine plates and particles as the growth rate was changed from 0.1 to 1 cm per hour. Above this rate, several morphologies (round microfaceted and chevron) were found. For growth rates above 2 cm per hour, the structure is properly described as a regular faceted (MnBi) / nonfaceted (Bi) eutectic, and the growth is cooperative when the growth direction is antiparallel to the gravity vector. CISTI

N93-16493# McMaster Univ., Hamilton (Ontario).

NUCLEATION, CRYSTAL GROWTH, AND LIQUID/LIQUID PHASE SEPARATION IN MATERIALS IN MICROGRAVITY, PHASE 3 Final Report, 1 Jun. 1989 - 31 Mar. 1990

S. Johar and Gyan P. Johari 31 Mar. 1990 97 p

(Contract DSS-31098-9-6013/04-SW)

(CTN-93-60612) Avail: CASI HC A05/MF A02

In a research program investigating the behavior of glasses and other materials in microgravity, a furnace apparatus for crystallization and microstructure development studies was modified and used in heat treating specimens in one gravity and in the microgravity environment aboard KC-135 flights. The apparatus contains six heat-treating furnaces, where the temperature of each furnace can be independently controlled for flexibility in the experiments, and the temperature and accelerometer signals can be recorded using a data logger. Specimen holders were redesigned to decrease the possibility of alignment failure which was noted in earlier flights. Additional experiments were performed on the KC-135 on inorganic and metallic glasses and amorphous polymer specimens, some of which were analyzed using optical microscopy and x-ray diffraction. Differences in crystallization and liquid-liquid separation behavior between terrestrial and microgravity environments are noted. Another apparatus was designed and constructed to measure thermal diffusivity in fluid under microgravity, and was successfully used in KC-135 experiments. Results from these thermal conduction studies show a cyclic pattern in the heat transfer through the liquid column. CISTI

N93-16494# Nova Scotia Research Foundation Corp., Dartmouth.

EXAMINATION OF THE DISINTEGRATION OF LIQUID AND SLURRY LIGAMENTS UNDER MICROGRAVITY CONDITIONS Final Report

Neil Stover May 1991 54 p

(Contract DSS-31016-0-6073/01-SW)

(CTN-93-60615) Avail: CASI HC A04/MF A01

Experiments were carried out under reduced gravity conditions to evaluate the surface tension driven and viscosity resisted formation of drops from cylindrical shaped fluids (ligaments). The fluids tested were water, water plus carboxymethyl cellulose at three concentrations (pseudoplastic without thixotropy), and a 70 weight percent coal coal/water slurry (pseudoplastic with thixotropy). The fluid ligaments were generated with zero velocity in relation to the data acquisition system. The drop formation data were collected by video recording. The rheological properties of the fluids were evaluated using a Searle type rotational viscosimeter at shear rates up to 450/s. The surface tension of the fluids was measured using both a ring and a drop weight type apparatus. The number of drops formed was insufficient for allowing statistically significant correlations to be developed with dimensionless parameters such as the Reynolds, Weber, and Ohnesorge numbers. Modifications to the experimental apparatus have been recommended which will improve its operation. Author (CISTI)

N93-16496# Carleton Univ., Ottawa (Ontario). Dept. of Mechanical and Aerospace Engineering.

A STUDY OF THE STABILITY OF TWO-LIQUID DROPLETS UNDER MICROGRAVITY CONDITIONS Final Report

S. A. Sjolander Apr. 1989 45 p

(Contract DSS-31098-8-6058/02-SW)

(CU-MAE-89-01; CTN-93-60618) Avail: CASI HC A03/MF A01

An initial examination is made of the isothermal interaction of droplets of two immiscible fluids immersed in a third immiscible fluid. A nondimensional engulfment parameter is introduced which has been found to be a useful measure of the engulfment characteristics of the interacting fluids. In addition, a simplified analysis is made of the overall stability of the equilibrium states which the droplets can achieve. Based on the analysis and a review of the literature, a simple apparatus is proposed for investigating droplet interactions experimentally, both in the laboratory and under microgravity conditions. The apparatus consists of a chamber in which concentric and adjacent droplets can be formed and their behavior recorded photographically. The apparatus can be modified easily for future studies of the effect of temperature variations (Marangoni effects) on the droplets. Author (CISTI)

N93-16547# Aastra Aerospace, Inc., Downsview (Ontario).

A STUDY FOR PROTEIN CRYSTALLIZATION IN MICROGRAVITY Final Report

12 Jan. 1989 104 p

(Contract DSS-31098-8-6020/01-SW)

(Rept-3211-ER-02-Vol-1; CTN-93-60617) Avail: CASI HC A06/MF A02

A review of protein crystallography and protein crystallization techniques is presented, and the reasons for investigating protein crystallization in microgravity are noted. Current research on growing protein crystals in microgravity is reviewed along with descriptions of the experimental hardware used. Canadian research programs in this field are also reviewed, and information gathered from a survey conducted to define the requirements for a space-based protein crystallization facility is summarized. In general, the predominant technique for growing protein crystals is the hanging drop method, and the following parameters were among those identified as requiring control in a space experiment: precipitant type and concentration, protein concentration, system pH, temperature, and vibration. The microgravity requirements for protein crystallization are specified and options for accessing microgravity are identified, focusing on satellites and space shuttles. Instrumentation technology for measuring protein crystallization parameters is evaluated, and requirements for a self-contained experiment facility for protein crystallization in microgravity are presented. CISTI

N93-16644# National Optics Inst., Ste-Foy (Quebec).

PRELIMINARY STUDY FOR A FLUID OPTICAL ANALYSIS SYSTEM IN MICROGRAVITY ADAPTED TO CANADIAN NEEDS Final Report

Pierre Langlois and Eric Harvey 20 Mar. 1989 154 p

(Contract DSS-31098-8-6066/01-SW)

(CTN-93-60625) Avail: CASI HC A08/MF A02

To study the feasibility of a microgravity fluid optical analysis system adapted to Canadian needs, a questionnaire survey was conducted among Canadian scientists and a bibliographic document containing 270 references on optical fluid analysis was prepared for selecting the most suitable optical techniques. Real time holographic interferometry and Moire deflectometry were selected as the two most powerful techniques. Preliminary experiments were conducted to observe fluid behavior during the heating of air with a soldering iron, heating of water with a laser, heating of a resistor in water,

dissolving of sugar in water, illumination of a light bulb, and dissolving a sugar cube in water. In these experiments, holography and shadowgraphy were compared. Laser material processing was identified as having the best potential for the integration of the holographic fluid analysis system to a Canadian experiment. CISTI

N93-16690# Queens Univ., Kingston (Ontario). Dept. of Metallurgical Engineering.

THE INFLUENCE OF MICROGRAVITY ON THE MICROSTRUCTURE AND PROPERTIES OF EUTECTICS, PHASE 4 Final Report

Reginald Smith 1991 62 p

(Contract DSS-31098-8-6034/01-SW)

(CTN-93-60629) Copyright Avail: CASI HC A04/MF A01

A study was undertaken to investigate the effect of microgravity on the structure of eutectic alloys. The experiments included unidirectional solidification and crystal growth in a specially designed control unit, modification treatment of microstructures, Soret effect experiments, and study of gas-eutectic reactions. The microgravity experiments were conducted aboard the KC-135 aircraft. Alloy systems examined included Fe-Cr-C, Ag-O, Cu-MgCu2, Ag-Cu, and Al-Cu. A qualitative model is suggested to explain the long pore formation observed in some alloys. From micrographs of samples grown during the KC-135 flights, it is seen that due to Soret diffusion, the primary phase formed at the solid/liquid interface, and that due to fast growth of the sample, the lamellar spacing is fine and no difference can be seen between the 2-gravity and microgravity periods. These experiments also support the qualitative explanation of pore formation. CISTI

N93-16694*# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering.

A STUDY OF FORCED CONVECTION BOILING UNDER REDUCED GRAVITY Final Report, 2 Jan. 1985 - 31 Dec. 1990

Herman Merte, Jr. Nov. 1992 196 p

(Grant NAG3-589; RTOP 506-41-51)

(NASA-CR-190771; E-7417; NAS 1.26:190771) Avail: CASI HC A09/MF A03

This report presents the results of activities conducted over the period 1/2/85-12/31/90, in which the study of forced convection boiling under reduced gravity was initiated. The study seeks to improve the understanding of the basic processes that constitute forced convection boiling by removing the buoyancy effects which may mask other phenomena. Specific objectives may also be expressed in terms of the following questions: (1) what effects, if any, will the removal of body forces to the lowest possible levels have on the forced convection boiling heat transfer processes in well-defined and meaningful circumstances? (this includes those effects and processes associated with the nucleation or onset of boiling during the transient increase in heater surface temperature, as well as the heat transfer and vapor bubble behaviors with established or steady-state conditions); and (2) if such effects are present, what are the boundaries of the relevant parameters such as heat flux, heater surface superheat, fluid velocity, bulk subcooling, and geometric/orientation relationships within which such effects will be produced? Author

N93-16717*# Alabama Univ., Huntsville. Center for Automation and Robotics

DROP TUBE RESEARCH Final Report

Gary L. Workman 12 Nov. 1992 15 p

(Contract NAS8-38609)

(NASA-CR-191415; NAS 1.26:191415) Avail: CASI HC A03/MF A01

This report covers the activities performed in the Drop Tube Study which The University of Alabama in Huntsville designed, fabricated and performed various low gravity experiments in materials processing from November 1, 1991 through October 30, 1992. During the performance of this contract the utilization of these ground-based containerless processing facilities has been instrumental in providing the opportunity to determine the feasibility of performing a number of solidification experiments in a simulated space environment, without the expense of a space-based experiment. A number of periodic reports have been given to the TCOR during the course of this contract hence this final report is meant only to summarize the many activities performed and not redundantly cover materials already submitted. Author

N93-16729# Manitoba Univ., Winnipeg. Dept. of Mechanical Engineering.

DEVELOPMENT OF EQUIPMENT AND TECHNIQUE TO STUDY SOLIDIFICATION IN MICROGRAVITY, PHASE 1 Final Report

M. C. Chaturvedi, K. N. Tandon, and J. R. Cahoon 31 Mar. 1989 51 p

(CTN-93-60608) Avail: CASI HC A04/MF A01

Convective mixing has a strong influence on the microstructure, micro segregation, and macro segregation of metal and alloy castings. By comparing these parameters in samples processed on ground and in microgravity, the fundamental mechanisms involved in solute segregation and dendrite multiplication can be better understood. With this objective in mind, a technique and apparatus were developed for directional solidification of Al-4 percent Cu alloy. The apparatus, which includes a furnace and a graphite crucible, is suitable for microgravity experiments aboard a sounding rocket or other spacecraft. The apparatus, including temperature recording and control instrumentation, was tested satisfactorily. Several preliminary experiments were conducted to produce columnar grains by chilling the bottom of the crucible. The technique was perfected by using a fine grade graphite for the crucible and by introducing a low melting point alloy sheet between the chill block and the bottom. The Al-4 percent Cu ingots produced from the apparatus displayed excellent directional columnar grains. Some data regarding the dendrite arm spacing and segregation have been collected which agree with published data. Author (CISTI)

N93-16730# Aastra Aerospace, Inc., Downsview (Ontario).

A STUDY OF PROTEIN CRYSTALLIZATION IN MICROGRAVITY. PHASE 2: SYSTEM SPECIFICATION FOR NUCLEATION DETECTION SYSTEM FOR SPACE FACILITY Final Report

W. Kung and D. Uffen Jul. 1990 67 p

(Contract DSS-31016-9-6067/01-SW)

(Doc-3296-ER-01; CTN-93-60624) Avail: CASI HC A04/MF A01

As part of an initial step in the development of an advanced system for nucleation detection for eventual inclusion in a space-based protein crystallization facility, the operating principle and required equipment for nucleation measurements are described. The nucleation detection system is based on dynamic light scattering (DLS) measurements of the effective hydrodynamic size of the protein molecules and aggregates in solution. Current information on commercial DLS systems is included. Research in the application of DLS measurements to protein crystallography is reviewed. This work has shown that it is possible to use DLS measurements to distinguish between conditions that lead to the formation of protein crystals and those that do not. A design for a bench-top nucleation detection system based on a commercial DLS system is presented. The design results in minimal changes to commercial equipment yet allows the ability to change the solution parameters in order to adjust the nucleation conditions. A modified vapor diffusion technique is used to obtain protein crystals. Some of the issues concerning the miniaturization of this equipment for spaceborne use are discussed. Author (CISTI)

N93-16746# University of Western Ontario, London. Dept. of Electrical Engineering.

A STUDY OF THE DYNAMICS OF DROPLET BREAK-UP Final Report

Rasmus Kromann and Ion I. Inculet 29 Mar. 1988 16 p

(Contract DSS-31098-7-6022/01-SW)

(CTN-93-60621) Avail: CASI HC A03/MF A01

Experimental equipment to be used for investigating droplet formation, internal flow, and breakup under microgravity conditions in the KC-135 aircraft is described. The equipment includes a photographic system incorporating a Hycam high speed camera, a ring light with eight 300-W lamps, three front-coated aluminum mirrors mounted to allow photographing droplets from three perpendicular axes at the same time, and associated power supplies. The droplet formation apparatus includes a stepmotor controlled syringe pump for forming and injecting water droplets into a suitable location in between the mirrors and the camera. Internal flow in the water will be visualized by plastic tracer beads. The drops will be broken up by high voltage electrodes. A timer circuit is used to control the sequence of events during experiments. Most of the equipment will be mounted on a 24 by 38 in. baseplate provided with roll bars. CISTI

N93-16747*# Physical Sciences, Inc., Andover, MA.

MULTICOLOR PYROMETER FOR MATERIALS PROCESSING IN SPACE Final Report, 1 Jun. 1987 - 30 Nov. 1989

M. B. Frish, J. Frank, J. E. Baker, R. R. Foutter, H. Beerman, and M. G. Allen Mar. 1990 102 p Original contains color illustrations
(Contract NAS7-1002)
(NASA-CR-190876; NAS 1.26:190876) Avail: CASI HC A06/MF A02; 1 functional color page

This report documents the work performed by Physical Sciences Inc. (PSI), under contract to NASA JPL, during a 2.5-year SBIR Phase 2 Program. The program goals were to design, construct, and program a prototype passive imaging pyrometer capable of measuring, as accurately as possible, and controlling the temperature distribution across the surface of a moving object suspended in space. These goals were achieved and the instrument was delivered to JPL in November 1989. The pyrometer utilizes an optical system which operates at short wavelengths compared to the peak of the black-body spectrum for the temperature range of interest, thus minimizing errors associated with a lack of knowledge about the heated sample's emissivity. To cover temperatures from 900 to 2500 K, six wavelengths are available. The preferred wavelength for measurement of a particular temperature decreases as the temperature increases. Images at all six wavelengths are projected onto a single CCD camera concurrently. The camera and optical system have been calibrated to relate the measured intensity at each pixel to the temperature of the heated object. The output of the camera is digitized by a frame grabber installed in a personal computer and analyzed automatically to yield temperature information. The data can be used in a feedback loop to alter the status of computer-activated switches and thereby control a heating system. Author

N93-16918# McMaster Univ., Hamilton (Ontario). Dept. of Material Science and Engineering.
NUCLEATION, CRYSTAL GROWTH AND LIQUID/LIQUID PHASE SEPARATION STUDIES IN INORGANIC GLASSES AND GLASSY-METALS, PHASE 1 Final Report
S. Johar and G. P. Johari 15 Mar. 1988 54 p
(CTN-93-60630) Avail: CASI HC A04/MF A01

As part of a research program conducted to improve the theoretical understanding of crystallization and liquid/liquid phase separation phenomena in inorganic and metallic glasses, the state of the art in this field was assessed and a preliminary framework was developed in which a detailed experimental program could be initiated. A series of preliminary experiments was conducted to generate a large enough data base for planning microgravity experiments. The glasses used in the experiments were selected on their usefulness as a model system for nucleation, cystallization or liquid/liquid phase separation studies, availability of experimental data, and the ease with which the microgravity experiments could be performed. The experimental materials included BaO-B2O3, Na2O-B2O3, Li2O-ZnO-SiO2, and Na2O-B2O3-SiO2 glasses, and Fe-Ni-B and Co-Fe-Si-B metallic glasses. X-ray diffraction, scanning electron microscopy, and optical microscopy were used to study crystallization and phase separation behavior. A number of parameters important for the microgravity experiments were identified. On the basis of the laboratory experiments and the identified parameters, a conceptual design of a microgravity furnace was developed. CISTI

N93-16934# Victoria Univ. (British Columbia). Dept. of Mechanical Engineering.
MATHEMATICAL MODELLING AND COMPUTER SIMULATION OF CRYSTAL GROWTH FROM LIQUID PHASE UNDER MICROGRAVITY CONDITIONS, PHASE 2 Final Report
Sadik Dost, Husnu A. Erbay, and Saadet Erbay 31 Mar. 1992 123 p
(Contract DSS-9F007-1-6000/01-SW)
(CTN-93-60620) Avail: CASI HC A06/MF A02

A two-dimensional model based on fluid flow and mass transport was used to simulate dissolution and liquid phase epitaxial growth of Si from an In solution in a sandwich system. The results are found to be in very good qualitative and quantitative agreement with experiments. In particular, the observed differences between upper and lower substrate thicknesses are correctly predicted for both dissolution and growth processes. This phenomenon is explained in terms of the predominance of convection in the lower part of the sandwich cell, in the case of dissolution, and in the upper part, in the case of growth. In both processes, a smooth substrate surface was obtained in the diffusion dominated region, and this behavior has been confirmed in experiments. The effects of gravity on dissolution depths were also tested in simulations. For liquid phase electroepitaxy (LPEE) growth of GaAs, the first step in the modelling which is concerned with the two-dimensional thermal analysis of the growth furnace, has been completed. The model is based on heat transport considerations. A new definition of the temperature change at the solution substrate interface has been devised which clearly characterizes the contribution of the Peltier effect in the process. Author (CISTI)

N93-16936# Queens Univ., Kingston (Ontario). Dept. of Metallurgical Engineering.
THE INFLUENCE OF MICROGRAVITY ON THE MICROSTRUCTURE AND PROPERTIES OF EUTECTICS, PHASE 3 Final Report
Reginald Smith 1991 56 p
(Contract DSS-31098-8-6034/01-SW)
(CTN-93-60628) Avail: CASI HC A04/MF A01

A study was conducted on Mn-Bi-Te ternary alloys to determine the effects of thermodiffusion (Soret effect) on their microstructure, both on earth and under microgravity conditions during flights of the KC-135 aircraft. High purity Bi-MnBi eutectic and near-eutectic alloys, as well as Bi-Mn-Te alloys, were prepared and unidirectionally solidified using a Bridgman-type furnace arrangement. The processed samples were examined by optical microscope and chemical analysis. Phase diagrams were computed using F*A*C*T software. Results indicate that no pronounced ternary eutectic microstructure was obtained in spite of extensive searches. It was evident, however, that the F*A*C*T programs are able to model the alloy system effectively. Examination of microgravity samples showed that a homogeneous distribution of Mn could be obtained; however, the particle size was quite large. Most of the particles appeared to have no peritectic reaction zone, suggesting that they may not be the equilibrium crystal structure but some metastable form. CISTI

N93-16937# McMaster Univ., Hamilton (Ontario). Dept. of Materials Science and Engineering.
NUCLEATION, CRYSTAL GROWTH AND LIQUID/LIQUID PHASE SEPARATION STUDIES IN INORGANIC GLASSES, GLASSY-METALS AND POLYMERS, PHASE 2 Final Report
S. Johar and G. P. Johari 31 Mar. 1989 95 p
(CTN-93-60631) Avail: CASI HC A05/MF A01

Laboratory studies for the preparation of glasses and other materials for microgravity crystallization studies were completed. On the basis of the thermal behavior of these materials, suitable compositions were selected for KC-135 microgravity experiments. These materials included oxide glasses, metallic glasses, and a poly(vinyl methyl acrylate) poly(styrene) polymer. An experimental apparatus suitable for heating and cooling multiple specimens in the limited time of microgravity during KC-135 flights was designed, developed, and tested. The apparatus included an electric furnace block assembly, a quenching block made of copper, a specimen holder and drive mechanism, and related electrical, electronic, and structural assemblies. Details are provided of these components and their modifications after successful experiments conducted on the KC-135. Selected specimens from laboratory and microgravity experiments were characterized using optical and electron microscopy. Significant differences in crystal growth and liquid-liquid phase separation were observed, involving effects brought about by the absence of convection or the dominance of surface tension forces or Marangoni flow as a mechanism for heat transfer. CISTI

N93-17548# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.
RESPONSE OF A ROTATING ANCHORED FINITE ANNULAR LIQUID LAYER TO AXIAL EXCITATION
Helmut F. Bauer 1991 23 p
(LRT-WE-9-FB-6-1991; ETN-92-92584) Avail: CASI HC A03/MF A01

A solidly rotating finite annular liquid layer consisting of nonviscous liquid was subjected to axial harmonic excitation in a zero gravity envionment. The layer exhibited an anchored free liquid surface at the discs at which it was located. The stuck edge condition, which is due to surface tension effects, has a definite influence upon the vibrational behavior of the layer. The response of the free liquid surface elevation and the velocity in radial and axial direction were determined in the elliptic forcing frequency range omega greater than 2(omega (sub 0)) and the hyperbolic range omega less than 2(omega sub 0) for different diameter ratios. ESA

N93-17551# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.
RESPONSE OF AN ANNULAR CYLINDRICAL LIQUID LAYER WITH ANCHORED EDGES IN ZERO-GRAVITY
Helmut F. Bauer 1991 29 p
(LRT-WE-9-FB-8-1991; ETN-92-92586) Avail: CASI HC A03/MF A01

An annular liquid layer with anchored edges was subjected in a zero gravity environment to harmonic axial excitation. The liquid was treated as frictionless and was held together by free surface tension, which acted as the restoring force. The axisymmetric natural frequencies and the response of the system were determined. The free surface elevation and the velocity distribution were obtained analytically. It was found that the first resonance response is sharply tuned and could easily be missed in a seeping experiment and that the stuck edge frequencies are higher than those of the freely slipping edge. ESA

N93-17602# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.
HYDROELASTIC VIBRATIONS IN A RECTANGULAR CONTAINER UNDER ZERO-GRAVITY
Helmut F. Bauer 1991 115 p
(LRT-WE-9-FB-28-1991; ETN-92-92737) Avail: CASI HC A06/MF A02

In zero gravity conditions, the liquid surface in a container exhibits a displaced equilibrium position which depends upon the magnitude of the contact angle to the wall, due to surface tension effects. For these conditions, the interactions of a liquid with a free surface in a rectangular container with flexible bottom under zero gravity condition were investigated. The bottom was considered as a flexible membrane or a thin elastic plate, and for both cases, the coupled frequencies were determined. It was found that a more flexible container bottom increases the coupled liquid frequencies which are more pronounced for small liquid heights. Larger liquid heights show less effect upon the coupled liquid frequencies but a stronger effect on the coupled membrane frequency. ESA

N93-17335*# Alabama Univ., Birmingham. Dept. of Physics.
AN EXPERIMENT TO STUDY FULLERENE FORMATION UNDER REDUCED GRAVITY
Thomas J. Wdowiak *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N93-15896# Oak Ridge National Lab., TN.
MAGNETIC REFRIGERATION CYCLE ANALYSIS USING SELECTED THERMODYNAMIC PROPERTY CHARACTERIZATIONS FOR GADOLINIUM GALLIUM GARNET
R. W. Murphy Sep. 1992 12 p Presented at the 6th Annual New York State Inst. on Superconductivity Conference on Superconductivity and Applications, Buffalo, NY, 15-17 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE93-000448; CONF-920944-3) Avail: CASI HC A03/MF A01

Magneto-thermodynamic property characterizations were selected, adapted, and compared to material property data for gadolinium gallium garnet in the temperature range 4 to 40 K and magnetic field range 0 to 6 T. The most appropriate formulations were incorporated into a model in which methods similar to those previously developed for other materials and temperature ranges were used to make limitation and relative performance assessments of Carnot, ideal regenerative, and pseudo-constant field regenerative cycles. Analysis showed that although Carnot cycle limitations on available temperature lift for gadolinium gallium garnet are not as severe as those for materials previously examined, substantial improvements in cooling capacity/temperature lift combinations can be achieved using regenerative cycles within specified field limits if significant loss mechanisms are mitigated. DOE

N93-16265# ManTech Environmental Technology, Inc., Dayton, OH.
METABOLITE IDENTIFICATION OF HALON REPLACEMENT COMPOUNDS Final Report, Mar. 1991 - Mar. 1992
W. T. Brashear, M. M. Ketcha, D. L. Pollard, C. S. Godin, and H. F. Leahy Jun. 1992 38 p
(Contract F33615-90-C-0532)
(AD-A256344; AL-TR-1992-0078) Avail: CASI HC A03/MF A01

Halon 1211 is currently being used by the U.S. Air Force as a flight line fire extinguishant. Because of health and environmental concerns over ozone depletion, Halon 1211 must be phased out by the year 2000. Before an interim replacement can be chosen, the toxicity of prospective candidates needs to be evaluated. The metabolism was studied of the Halon replacement candidates perfluorohexane (PFH) and the hydrochlorofluorocarbons (HCFCs): HCFC-123, HCFC-124, and HCFC-142b. Fischer 344 and Sprague-Dawley rats were exposed via inhalation to a 1 pct. atmosphere for 2 h. Tissues were analyzed for volatile metabolites, and urine was analyzed for fluoride and carboxylic acid metabolites. Animals exposed to HCFC-123 or IICFC-124 excreted trifluoroacetic acid in their urine. The presence of trifluoroacetic acid indicates oxidative metabolism of HCFC-123 and IICFC-124. Increased fluoride was found in the urine of rats exposed to HCFC-124. HCFC-142b was metabolized to chlorodifluoroacetic acid, which was found in the urine of exposed rats. Fischer 344 and Sprague-Dawley rats exposed to HCFC-123 had small amounts of HCFC-133a and 2-chloro-1,1-difluoroethylene in liver tissue. The identification of HCFC-133a and 2-chloro-1,1-difluoroethylene following exposure indicates reductive metabolism of HCFC-123. No metabolites of PFH or Halon 1211 were identified in these investigations. Rats exposed to Halon 1211 had slightly elevated bromide levels in their urine compared to control values. GRA

N93-16682*# Martin Marietta Corp., New Orleans, LA. Manned Space Systems.
CYCLE 0(CY1991) NLS TRADE STUDIES AND ANALYSES REPORT. BOOK 1: STRUCTURES AND CORE VEHICLE Final Report
Jan. 1992 673 p
(Contract NAS8-37143)
(NASA-CR-184471; NAS 1.26:184471; MMC-NLS-SR.001-Bk-1) Avail: CASI HC A99/MF A06

This report (SR-1: Structures, Trades, and Analysis), documents the Core Tankage Trades and analyses performed in support of the National Launch System (NLS) Cycle 0 preliminary design activities. The report covers trades that were conducted on the Vehicle Assembly, Fwd Skirt, LO2 Tank, Intertank, LH2 Tank, and Aft Skirt of the NLS Core Tankage. For each trade study, a two page executive summary and the detail trade study are provided. The trade studies contain study results, recommended changes to the Cycle 0 Baselines, and suggested follow on tasks to be performed during Cycle 1. Author

N93-17367# Oak Ridge National Lab., TN.
LABORATORY EVALUATION OF AN OZONE-SAFE NONAZEOTROPIC REFRIGERANT MIXTURE IN A LORENZ-MEUTZNER REFRIGERATOR FREEZER DESIGN
J. R. Sand, E. A. Vineyard, and V. D. Baxter 1992 32 p Presented at the Winter Meeting of the American Society of Heating, Refrigeration and Air Conditioning Engineers, Chicago, IL, 23-27 Jan. 1993
(Contract DE-AC05-84OR-21400)
(DE92-041252; CONF-930118-2) Avail: CASI HC A03/MF A01

The Lorenz-Meutzner refrigerator freezer (RF) circuit has been proposed as a design which would operate with nonazeotropic refrigerant mixtures (NARMS) and significantly increase the thermodynamic efficiency of household refrigerators. Several ozone-safe and more environmentally acceptable refrigerants are known which could be blended into a NARM to replace R-12 for this domestic refrigeration application. Laboratory tests were performed on a Lorenz-Meutzner (L-M) RF using an R-32/R-124 NARM. Comparisons are made between the baseline performance of the refrigerator with R-12 before it was modified to the L-Ni design and that of the L-M circuit operating with R-12 and the NARM. Circuiting and component changes resulting from initial testing of this unit are described. Computer modeling and compressor calorimeter results for R-12 and the NARM used in the test unit are also presented. Small performance gains (approximately 3 percent) are seen for the NARM over R-12 in the same refrigerator freezer circuit. Modeling results and steady-state data suggest

larger improvements (approximately 15 percent) are possible. It is felt that the larger improvements predicted from modeling and compressor calorimetry data are not being realized due to poor heat transfer and refrigerant circuiting arrangements. DOE

N93-17497# Los Alamos National Lab., NM.
STATIC-STRESS ANALYSIS OF DUAL-AXIS CONFINEMENT VESSEL
D. H. Bultman Nov. 1992 21 p
(Contract W-7405-eng-36)
(DE93-000499; LA-12434-MS) Avail: CASI HC A03/MF A01

This study evaluates the static-pressure containment capability of a 6-ft-diameter, spherical vessel, made of HSLA-100 steel, to be used for high-explosive (HE) containment. The confinement vessel is designed for use with the Dual-Axis Radiographic Hydrotest Facility (DARHT) being developed at Los Alamos National Laboratory. Two sets of openings in the vessel are covered with x-ray transparent covers to allow radiographic imaging of an explosion as it occurs inside the vessel. The confinement vessel is analyzed as a pressure vessel based on the ASME Boiler and Pressure Vessel Code, Section 8, Division 1, and the Welding Research Council Bulletin, WRC-107. Combined stresses resulting from internal pressure and external loads on nozzles are calculated and compared with the allowable stresses for HSLA-100 steel. Results confirm that the shell and nozzles of the confinement vessel are adequately designed to safely contain the maximum residual pressure of 1675 psi that would result from an HE charge of 24.2 kg detonated in a vacuum. Shell stresses at the shell-to-nozzle interface, produced from external loads on the nozzles, were less than 400 psi. The maximum combined stress resulting from the internal pressure plus external loads was 16,070 psi, which is less than half the allowable stress of 42,375 psi for HSLA-100 steel. DOE

N93-17741# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Gennevilliers (France).
THE ELECTROCHEMICAL MACHINING OF NICKEL BASED ALLOYS [L'USINAGE ELECTROCHIMIQUE D'ALLIAGES BASE NICKEL]
Laurence Basseguy and Claude Faucheux (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Corbeil, France) 1991 6 p Repr. from Galvano-Organo-Traitements de Surface, v. 613, Feb. 1991 p 131-136 In FRENCH
(DS-1933; ETN-93-93376) Avail: CASI HC A02/MF A01

The principles of Electro Chemical Machining (ECM), which is based on the anodic dissolution of the material to be machined, are recalled. The procedure is similar to electropolishing and electrofettling. The piece to be machined forms the anode whilst the cathode is the tool which defines the geometry of the shape to be produced. The fundamental laws of ECM are given together with the choice of electrolyte and the electrochemical reactions taking place at the anode and cathode. An example of the application of ECM is given. Reasons for the choice of ECM as opposed to another fabrication procedure are given. ESA

N93-17770*# Georgia Inst. of Tech., Atlanta. School of Textile and Fiber Engineering.
DESIGN FOR PRODUCING FIBERGLASS FABRIC IN A LUNAR ENVIRONMENT
J. Lewis Dorrity, Suneer Patel, Rafer M. Benson, Michael C. Johnson, Mark A. Storey, Dai T. Tran, Thomas A. Zahr, and Dana R. Causby [1992] 8 p
(Contract NASw-4435)
(NASA-CR-192068; NAS 1.26:192068) Avail: CASI HC A02/MF A01

The purpose of this project was to design a method of producing a fabric material on the lunar surface from readily available glass fibers. Various methods for forming fabrics were analyzed to determine which methods were appropriate for the lunar conditions. A nonwoven process was determined to be the most suitable process for making a fabric material out of fiberglass under these conditions. Various resins were considered for adhering the fibers. A single thermoplastic resin (AURUM) was found to be the only applicable resin. The end product of the process was determined to be suitable for use as a roadway surfacing material, canopy materials, reflective material, or packaging material. A cost analysis of the lunar process versus shipping the end-product from the earth suggests that the lunar formation is highly feasible. A design for a lunar, nonwoven process was determined and included in the following document. Author

N93-17775*# Georgia Inst. of Tech., Atlanta. School of Textile and Fiber Engineering.
LUNAR PREFORM MANUFACTURING
Gregory N. Leong, Sandra Nease, Vicky Lager, Raffy Yaghjian, Chris Waller, and J. Lewis Dorrity [1992] 17 p
(Contract NASw-4435)
(NASA-CR-192064; NAS 1.26:192064) Avail: CASI HC A03/MF A01

A design for a machine to produce hollow, continuous fiber reinforced composite rods of lunar glass and a liquid crystalline matrix using the pultrusion process is presented. The glass fiber will be produced from the lunar surface, with the machine and matrix being transported to the moon. The process is adaptable to the low gravity and near-vacuum environment of the moon through the use of a thermoplastic matrix in fiber form as it enters the pultrusion process. With a power consumption of 5k W, the proposed machine will run continuously, unmanned in fourteen day cycles, matching the length of moon days. A number of dies could be included that would allow the machine to produce rods of varying diameter, I-beams, angles, and other structural members. These members could then be used for construction on the lunar surface or transported for use in orbit. The benefits of this proposal are in the savings in weight of the cargo each lunar mission would carry. The supply of glass on the moon is effectively endless, so enough rods would have to be produced to justify its transportation, operation, and capital cost. This should not be difficult as weight on lunar mission is at a premium. Author

N93-17778*# Georgia Inst. of Tech., Atlanta. School of Textile and Fiber Engineering.
NASA/USRA ADVANCED DESIGN PROGRAM ACTIVITY, 1991-1992 Final Report
J. Lewis Dorrity and Suneer Patel 1992 5 p
(Contract NASw-4435)
(NASA-CR-192063; NAS 1.26:192063) Avail: CASI HC A01/MF A01

The School of Textile and Fiber Engineering continued to pursue design projects with the Mechanical Engineering School giving the students an outstanding opportunity to interact with students from another discipline. Four problems were defined which had aspects which would be reasonably assigned to an interdisciplinary team. The design problems are described. The projects included lunar preform manufacturing, dust control for Enabler, an industrial sewing machine variable speed controllor, Enabler operation station, and design for producing fiberglass fabric in a lunar environment. Author

N93-15755# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany).
CHARACTERIZATION OF Al 2219 MATERIAL FOR THE APPLICATION OF THE SPIN-FORMING-PROCESS
D. Mueller-Wiesner, E. Sieger (Zeppelin-Metallwerke G.m.b.H., Friedrichshafen, Germany), and K. Ernsberger (Fachhochschule, Weingarten, Germany) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 755-760 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H., Bremen, Germany (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N93-15698# Federal Aviation Administration, Atlantic City, NJ.
FAA TECHNICAL CENTER AERONAUTICAL DATA LINK RESEARCH PLAN Final Report, Oct. 1991 - Sep. 1992
Frank Buck (Mitre Corp., Baileys Crossroads, VA.), Preston Cratch (Mitre Corp., Baileys Crossroads, VA.), Terence Fischer (Computer Technology Associates, Inc., Arlington, VA.), Joseph Lunder (TMA Technologies, Inc., Bozeman, MT.), Clark Shingledecker (NTI, Inc., Dayton, OH.), David Stahl

(Computer Technology Associates, Inc., Arlington, VA.), and David Sweeney (Mitre Corp., Baileys Crossroads, VA.) Oct. 1992 60 p
(Contract FAA-F2205-A)
(DOT/FAA/CT-92/23) Avail: CASI HC A04/MF A01

The purpose of this plan is to project a clear and distinct description of the Data Link research that is to be conducted at the Federal Aviation Administration (FAA) Technical Center over the next 4 years. It explicitly defines what is to be achieved at a specific time in the future. End-to-end, high fidelity simulations will be the primary methodology for answering research questions. The end-to-end simulations identified in this plan are intended to investigate controller/aircrew integration issues using candidate Data Link hardware and software configurations. Research will also focus on testing Data Link applications in terms of their impact on controllers, aircrew, and the overall safety, efficiency, and productivity of the system. Additionally, research efforts are planned to address the most critical human factors issues surrounding Data Link. Author

N93-15715*# Michigan Univ., Ann Arbor. Radiation Lab.
A FINITE ELEMENT-BOUNDARY INTEGRAL METHOD FOR CAVITIES IN A CIRCULAR CYLINDER
Leo C. Kempel and John L. Volakis 22 Dec. 1992 44 p
(Contract NCA2-653)
(NASA-CR-191381; NAS 1.26:191381; UMICH-028918-3-T) Avail: CASI HC A03/MF A01

Conformal antenna arrays offer many cost and weight advantages over conventional antenna systems. However, due to a lack of rigorous mathematical models for conformal antenna arrays, antenna designers resort to measurement and planar antenna concepts for designing non-planar conformal antennas. Recently, we have found the finite element-boundary integral method to be very successful in modeling large planar arrays of arbitrary composition in a metallic plane. We extend this formulation to conformal arrays on large metallic cylinders. In this report, we develop the mathematical formulation. In particular, we discuss the shape functions, the resulting finite elements and the boundary integral equations, and the solution of the conformal finite element-boundary integral system. Some validation results are presented and we further show how this formulation can be applied with minimal computational and memory resources.
Author

N93-15813# Texas Instruments, Inc., Plano, TX. Integrated Circuitry and Computers Dept.
RAPID PROTOTYPING OF APPLICATION SPECIFIC SIGNAL PROCESSORS PROGRAM Final Report, 5-10 Dec. 1992
Dennis Best, Reagan Branstetter, David Counts, Doug DeGroot, and Mark Eskew 9 Oct. 1992 168 p
(Contract MDA972-92-C-0060)
(AD-A257212) Avail: CASI HC A08/MF A02

This report discusses the results of the TI RASSP study efforts to identify a development process consistent with the RASSP program methodology. In this study, we defined the concept of a library based system design approach with in-cycle and out-of-cycle development of library elements. This report discusses this approach and the issues associated with system, hardware, and software design tools, and manufacturing foundry interfaces required to support a library based system development approach. The library based development concept is defined and the modularity and partitioning of a domain specific architecture is discussed. A description of the library elements supporting a library based system design approach is provided. Requirements, issues, and approaches to signal processing system design analyses and tradeoffs, and system simulation and validation are discussed. Data base representation issues, frame-words, and interfaces required to provide a seamless RASSP development environment are identified. Reusable software and library element development issues are addressed. Hardware CAD issues associated with library element development, system analyses, simulation, and validation are discussed. Manufacturing foundry CAD, CIM, design tool interfaces, and test issues are also discussed. A summary of the effort and recommendations for implementation are also included. GRA

N93-15817# Lockheed Missiles and Space Co., Palo Alto, CA. Research and Development Div.
SATELLITE TO SUBMARINE LASER COMMUNICATIONS (SLC): ADVANCED FILTER TECHNOLOGY Final Technical Report, 1 Aug. 1990 - 30 Nov. 1991
John D. Feichtner Jan. 1992 58 p
(Contract N00014-90-C-0184; ARPA Order 7531)
(AD-A257217; LMSC-P000187R) Avail: CASI HC A04/MF A01

This final report describes results of work to design, fabricate, and test narrow bandwidth, wide field of view (FOV) acousto-optic tunable filters (AOTF's) operating in the green spectral region. Such filters have potential for application in satellite to submarine optical communications (SLC) links. The AOTF tunability has advantages for both downlink and uplink communications. The motivation of the technical approach was to operate in the dispersive spectral region (5200-5500A) of CdS, where the high value of the dispersive constant produces narrow filter bandwidths. The goal of the work was to test the concept and characterize a filter based on CdS, limited by crystal absorption to wavelengths 5300 A or longer. For AOTF's in the blue and blue-green spectral regions, where the water losses in the optical link are lower, subsequent programs would investigate filters based on ZnS or the mixed crystals Zn(x)Cd(1-x)S, materials are not presently available in large sizes. A dispersive AOTF (DAOTF) based on CdS was fabricated and tested. The filter bandwidth ranged from 1 A to 3 A in the 5250-5400 A region. With one exception, polar angle FOV, the measured filter characteristics conform well-to performance predicted by the models developed in the course of the work. GRA

N93-15819# Stanford Univ., CA. Dept. of Statistics.
PROCEEDINGS OF THE CONFERENCE ON MOMENTS AND SIGNAL
P. Purdue and H. Solomon 21 Sep. 1992 391 p Conference held in Monterey, CA, 30-31 Mar. 1992
(Contract N00025-92-J-1264)
(AD-A257227; SU-TR-459) Avail: CASI HC A17/MF A04

The focus of this paper is (1) to describe systematic methodologies for selecting nonlinear transformations for blind equalization algorithms (and thus new types of cumulants), and (2) to give an overview of the existing blind equalization algorithms and point out their strengths as well as weaknesses. It is shown that all blind equalization algorithms belong in one of the following three categories, depending where the nonlinear transformation is being applied on the data: (1) the Bussgang algorithms, where the nonlinearity is in the output of the adaptive equalization filter; (2) the polyspectra (or Higher-Order Spectra) algorithms, where the nonlinearity is in the input of the adaptive equalization filter; and (3) the algorithms where the nonlinearity is inside the adaptive filter, i.e., the nonlinear filter or neural network. We describe methodologies for selecting nonlinear transformations based on various optimality criteria such as MSE or MAP. We illustrate that such existing algorithms as Sato, Benveniste-Goursat, Godard or CMA, Stop-and-Go, and Donoho are indeed special cases of the Bussgang family of techniques when the nonlinearity is memoryless. We present results that demonstrate the polyspectra-based algorithms exhibit faster convergence rate than Bussgang algorithms. However, this improved performance is at the expense of more computations per iteration. We also show that blind equalizers based on nonlinear filters or neural networks are more suited for channels that have nonlinear distortions. GRA

N93-15835# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
INSTRUMENTATION FOR MILLIMETER-WAVE POLARIMETRIC MEASUREMENTS OF INHOMOGENEOUS MEDIA Final Report, 1 Jul. 1991 - 31 Jun. 1992
Fawwas T. Ulaby and Kamal Sarabandi 1 Aug. 1992 8 p
(Contract DAAL03-91-G-0202)
(AD-A257255; ARI-TR-960; ARO-29146.1-GS-EQ) Avail: CASI HC A02/MF A01

ARO Contract DAAL-03-91-G-0202 is an instrumentation grant for upgrading the University of Michigan's millimeter-wave radar systems, which operate at 35, 94, 140, and 215 GHz. The funds were used to improve the data acquisition and control system, which operates all four channels, convert the 35 an 94 GHz systems into single-antenna configurations, convert the 140 GHz system into a coherent-on-receive polarimetric mode,

and add a bistatic scattering capability to the 35, 94, and 140 GHz systems. GRA

N93-15867# Naval Postgraduate School, Monterey, CA.
EFFECTS OF SURFACE-BASED DUCTS ON ELECTROMAGNETIC SYSTEMS M.S. Thesis
Eugenia L. Cairns-McFeeters Sep. 1992 139 p
(AD-A257443) Avail: CASI HC A07/MF A02

A study of the effect the atmosphere has on anomalous propagation is performed on an active radar fire control/guidance system operating around 13 GHZ and a passive Electronic Support Measure (ESM) countermeasure-(CM) system designed to detect signals in the 600 MHZ range. Atmospheric conditions for three different areas of the world were examined: the Persian Gulf, the Indian Ocean and the Caribbean. Also shown were the different effects horizontally homogeneous and inhomogeneous atmospheric profiles can have on electromagnetic (EM) systems. A comparison with a standard atmosphere was done for both the radar and the ESM system to show the effect ducting conditions have on extended signal strength. GRA

N93-15983# Naval Postgraduate School, Monterey, CA.
EVALUATION OF RADAR PERFORMANCE DEGRADATION DUE TO STANDOFF JAMMING M.S. Thesis
Yoon K. Chi Sep. 1992 74 p
(AD-A257316) Avail: CASI HC A04/MF A01

The performance degradation is evaluated of Airport Surveillance Radar (ASR-9) due to standoff jamming. ASR-9 data was taken from open literature on this civilian radar. Jammer parameters which are representative of the actual system were postulated to keep the study unclassified. Using these parameters the effect of standoff jamming on detection of targets is evaluated. This evaluation is performed by finding the change in radar SNR due to jamming and computing the probability of detection with and without jamming. GRA

N93-15987# Naval Postgraduate School, Monterey, CA.
RISK ASSESSMENT OF LAN COMMUNICATIONS M.S. Thesis
Mark A. Paylor Sep. 1992 81 p
(AD-A257327) Avail: CASI HC A05/MF A01

The National Computer Security Center's (NCSC) Computer Security Requirements--Guidance for Applying the DOD TCSEC in Specific Environments (CSC-STD-003-85) describes an environmental evaluation process which can be utilized to determine the level of trust required in a given Local Area Network (LAN) system for processing sensitive information. This thesis investigates the environmental evaluation process and applies it to the LAN environment of a hypothetical naval aviation squadron. GRA

N93-15989# Naval Postgraduate School, Monterey, CA.
FAST HIGH-RESOLUTION TECHNIQUES APPLIED TO THE DIRECTION OF ARRIVAL (DOA) OF SIGNALS PROBLEM M.S. Thesis
Milton P. Ferreira Sep. 1992 112 p
(AD-A257331) Avail: CASI HC A06/MF A02

Subspace decomposition methods are a very useful technique to extract the signal information via eigen-based estimators. Although those techniques are very accurate, they are usually expensive to update, becoming difficult to implement for real time applications. The Rank-Revealing QR (RRQR) factorization introduced by Chan, offers an alternative to perform the subspace selection. The RRQR algorithmis applied to the Direction of Arrival (DOA) problem to track moving sources, using passive linear arrays. In addition to the regular RRQR algorithm originally proposed by Chan, an improvement is introduced. This refinement uses the signal subspace information and requires very little additional computation. Advantage is taken of the Hermitian property of the signal correlation matrix and is implicitly equivalent to applying one subspace iteration step to the estimated signal subspace. Simulations show that the performance obtained is equivalent to that obtained using classical eigen-based techniques. Alternative algorithms for finding an approximation of the smallest singular vector of the correlation matrix are discussed and compared to the original method. The final product is an adaptive algorithm that allows for tracking of DOA angles when moving sources are present. An analysis of the number of flops needed to execute the adaptive algorithm based on the RRQR factorization to track the DOA of moving sources is included, showing its feasibility for being used in real time implementations. GRA

N93-15991# Naval Postgraduate School, Monterey, CA.
OPTIMAL LINEAR ARRAY HEADING IN A DIRECTIONAL NOISE FIELD M.S. Thesis
David C. McDonnell Sep. 1992 58 p
(AD-A257336) Avail: CASI HC A04/MF A01

A procedure is discussed that optimizes the signal-to-noise ratio (SNR) detected by a linear array in a directional ambient noise field. The SNR can be optimized by minimizing the ambient noise detected by the array. For a given target location, each possible heading of the array centers the ambiguous beam of the array at a different true bearing. Therefore, each heading of the array will receive a different ambient noise level. An optimal heading can be obtained which maximizes the SNR received by the array. For all possible headings the beam pattern of the array must be determined and combined with the ambient noise field to determine the noise level detected. This thesis discusses the theory involved in calculating the ambient noise levels detected for each heading and provides a computer program which performs the calculations for a particular array. GRA

N93-16001# Delta Information Systems, Inc., Horsham, PA.
STANDARDIZATION OF END-TO-END PERFORMANCE OF DIGITAL VIDEO TELECONFERENCING/VIDEO TELEPHONY SYSTEMS Final Report
Dec. 1991 100 p
(Contract DCA100-91-C-0031)
(AD-A257186; NCS-TIB-91-15) Avail: CASI HC A05/MF A02

This report covers the standardization of end-to-end performance for full motion videophone and video teleconferencing. It investigates the criteria for such a standardization on an end-to-end basis to ensure delivery of a specified quality of service for various Government TV applications. It is distinguished from the previous effort covered in TIB 90-6 by concentrating on a codec designed in accordance with CCITT Standard H.261. Section 2 of this report describes the available background material consisting of both previous NCS programs and related efforts performed in conjunction with the deliberations of ANSI Committee T1Q1.5. Section 3 contains the various criteria that had to be considered, concentrating on the test material and the characteristics of the codec under test. Section 4 describes the subjective evaluation of the processed test tapes which were rated in terms of picture impairment by a panel of impartial evaluators. Section 5 covers objective tests and includes the overall methodology and test results for three parameters which have previously been identified as important for the objective evaluation of codec performance. Correlation between subjective and objective test results is examined it Section 6. Section 7 discusses the overall results and adds a few not previously mentioned factors. Section 8 briefly summarizes the total program and suggests a number of follow-on tests which together will form a solid basis for an end-to-end performance standard for digital video teleconferencing/video telephony systems. GRA

N93-16052# Massachusetts Inst. of Tech., Lexington.
AN AGILE FREQUENCY SYNTHESIZER/RF GENERATOR FOR THE SCAMP TERMINAL
Harry M. Wolfson 2 Sep. 1992 117 p
(Contract F19628-90-C-0002)
(AD-A256777; TR-962; ESC-TR-92-076) Avail: CASI HC A06/MF A02

This report describes a combination agile synthesizer and reference frequency generator called the RF Generator, which was developed for use in the Advanced SCAMP (ASCAMP) program. The ASCAMP is a hand-carried, battery-powered, man-portable ground terminal that is being developed for EHF satellite communications. In order to successfully achieve a truly portable terminal, all of the subsystems and components in ASCAMP were designed with the following critical goals: low power, lightweight, and small size. The RF Generator is based on a hybrid design approach of direct digital and direct analog synthesis techniques that was optimized for small size, low power consumption, fast tuning, low spurious, and low phase noise. The RF Generator was conceived with the philosophy that simplicity of design would lead to a synthesizer that differentiates itself from those used in the past by its ease of fabrication and tuning. By avoiding more complex design approaches, namely, indirect analog (phase lock loops), a more easily produceable design could be achieved. An

effort was made to minimize the amount of circuitry in the RF Generator, thereby making trade-offs in performance versus complexity and parts count when it was appropriate. GRA

N93-16055*# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.

VIDEO CODING AND THE APPLICATION LEVEL FRAMING PROTOCOL ARCHITECTURE M. S. Thesis

Andrew T. Heybey Jun. 1991 70 p

(Grant NAG2-582)

(NASA-CR-192002; NAS 1.26:192002; AD-A256843; MIT/LCS/TR-542)

Avail: CASI HC A04/MF A01

As networks and computers become faster, real time video transmission is expected to become common. Variable bit rate video coders will be used in order to take advantage of the statistical multiplexing gain and bandwidth efficiency of packet switched networks. Video streams have different service requirements from the traffic usually carried on computer networks. A new protocol architecture called Application Level Framing (ALF) was proposed to allow efficient implementation of communications with diverse service requirements. ALF allows the application to control the way in which network errors are handled. The compatibility is studied of three proposed video coding standards with an ALF protocol architecture. Each of the standards is found to be usable with varying degrees of effort. A set of design principles for video codes intended for use over an ALF protocol architecture is presented. Author

N93-16059# RAND Corp., Santa Monica, CA.

RJARS: RAND'S VERSION OF THE JAMMING AIRCRAFT AND RADAR SIMULATION

William Sollfrey 1991 207 p

(Contracts F49620-91-C-0003; MDA903-91-C-0006)

(AD-A255560; RAND/N-2727-1-AF/A/DARPA/DR/E) Avail: CASI HC A10/MF A03

RJARS is an engagement level model that simulates air-to-ground and ground-to-air combat, primarily the latter, treating the combatants as individuals rather than aggregating. It has been designed to consider terrain masking, multipath and clutter, and flight dynamics in order to more carefully evaluate jamming effectiveness and mission attrition. The model is an extensive development of JARS (Jamming Aircraft and Radar Simulation). The current version of RJARS considers sorties in which aircraft carrying warning receivers, jammers, anti-radiation missiles, and air-launched cruise missiles fly against a defensive system with search, acquisition, and tracking radars, IR and optical systems, surface-to-air missiles, artillery, and a command, control, and communications system. All equipment parameters and scenarios can be varied. GRA

N93-16072# Lawrence Livermore National Lab., CA.

TWO-DIMENSIONAL COMPUTER CALCULATION OF HIGH-POWER MICROWAVE BANDWIDTH BROADENING BY AIR BREAKDOWN IN A RECTANGULAR WAVEGUIDE

D. J. Mayhall and J. H. Yee Jun. 1992 3 p Presented at the 19th IEEE International Conference on Plasma Science, Tampa, FL, 1-3 Jun. 1992

(Contract W-7405-eng-48)

(DE92-041083; UCRL-JC-109423; CONF-920638-1) Avail: CASI HC A01/MF A01

Wideband, high power microwave pulses may have a number of important applications in the future. Several of these applications may be in wideband radar. One way to generate these pulses with relatively conventional, presently existing technology is to remove the tails of high amplitude microwave pulses in a low pressure, air breakdown cell formed from a section of rectangular waveguide. The pressure for this tail erosion process must be matched to the characteristics of the incident pulse so that the air breakdown causes the desired amount of tail erosion. The tail erosion shortens the incident pulse and broadens the bandwidth of the transmitted pulse. The distribution of transmitted amplitude versus incident amplitude at several greater axial positions are presented. DOE

N93-16100# Los Alamos National Lab., NM.

POSSIBLE APPLICATION OF TRANSIENT ELECTROMAGNETIC PULSES TO HIGH BRIGHTNESS e-GUNS

N. A. Kurnit, P. K. Benicewicz, and A. J. Taylor 1992 18 p Presented at the Advanced Accelerator Concepts Workshop, Port Jefferson, NY, 14-20 Jun. 1992

(Contract W-7405-eng-36)

(DE92-040360; LA-UR-92-2858; CONF-9206193-7) Avail: CASI HC A03/MF A01

A number of groups have recently demonstrated the production of freely propagating, focusable pulses of terahertz radiation, consisting of essentially a single subpicosecond cycle of a baseband electromagnetic field. We discuss the possible application of these techniques to the production of strong fields at photocathode surfaces, in a manner analogous to radial-line switched-power concepts. Experimental status in production of these pulses in our laboratory and elsewhere is reviewed, and recent progress in development of short-pulse solid-state lasers useful for this technology is summarized. DOE

N93-16130# Massachusetts Univ., Amherst. Microwave Remote Sensing Lab.

POLARIMETRIC MEASUREMENTS OF NATURAL SURFACES AT 95 GHz Final Report

Paul S. Chang and Robert E. McIntosh 17 Aug. 1992 17 p

(Contract DAALO3-90-G-0144)

(AD-A256981; ARO-27919.2-GS) Avail: CASI HC A03/MF A01

A high power 95 GHz radar system, developed at the University of Massachusetts, was used to make polarimetric measurements of natural surfaces. Over the two year period of this grant, the following items were accomplished: (1) The 95 GHz radar was configured into a unique system capable of simultaneously making coherent and incoherent Mueller matrix measurements; (2) The equivalence of the coherent and noncoherent measurement technique was demonstrated; (3) The polarimetric properties of various foliage targets were characterized. These included the weeping willow, the sugar maple, and the white pine tree species; (4) The polarimetric properties of various snowcover types were characterized; and (5) Mueller matrix models for wet and dry snow were developed. GRA

N93-16207# Texas A&M Univ., College Station. Dept. of Electrical Engineering.

RADIATION, SCATTERING, AND GUIDANCE OF ELECTROMAGNETIC FIELDS BY ARBITRARILY SHAPED STRUCTURES EMBEDDED IN LAYERED DIELECTRIC MEDIA Quarterly Progress Report, 1 Jul. - 30 Sep. 1992

K. A. Michalski 30 Sep. 1992 1 p

(Contract N00014-90-J-1197)

(AD-A256937) Avail: CASI HC A01/MF A01

The validation of the waveguide-excited microstrip patch antenna code has been completed. The code is presently being applied to achieve impedance-matched antenna configurations. Also, various avenues are being explored to further increase the efficiency of the code. An effort has been initiated to incorporate curved isoparametric finite elements into the mixed potential integral equation formulation for arbitrarily shaped microstrip structures. This approach should allow us to more accurately model irregular microstrip geometries and to reduce the computational effort. GRA

N93-16220# Stanford Linear Accelerator Center, CA.

HIGH POWER RF WINDOW AND WAVEGUIDE COMPONENT DEVELOPMENT AND TESTING ABOVE 100 MW AT X-BAND

W. R. Fowkes, R. S. Callin, and A. E. Vlieks Aug. 1992 3 p Presented at the 16th International LINAC Conference, Ottawa, Ontario, 23-28 Aug. 1992

(Contract DE-AC03-76SF-00515)

(DE93-001809; SU-SLAC-PUB-5877; CONF-9208109-46) Avail: CASI HC A01/MF A01

SLAC is committed to developing an X-band source capable of producing 100 Megawatt, 1 microsecond pulses to power the next linear collider. The first experience encountered at SLAC in the X-Band Regime above a few Megawatts was in the relativistic klystron program in cooperation with LLNL and LBL. About 280 MW had been transmitted through a variety of waveguide components but at very short pulse widths (approximately 40 nanseconds) and very low pulse repetition rates. The likelihood of high peak power RF breakdown in most X-band components and especially RF windows increases as the RF pulse length becomes longer. Testing components at peak power levels above that at which they are expected to reliably perform is essential in a development program. DOE

N93-16300# Human Engineering Labs., Aberdeen Proving Ground, MD.
ENHANCEMENT OF VIDEO IMAGERY BY MODIFIED INTENSITY-DEPENDENT SPATIAL SUMMATION Final Technical Report
Phillip G. Harnden, Frank F. Holly, Dale R. Shires, Salvatore P. Schipani, and C. A. Chang Jul. 1992 17 p
(DA Proj. 1L1-61102-B-74-A)
(AD-A255689; HEL-TN-9-92) Avail: CASI HC A03/MF A01

A contract-enhancement algorithm is described which avoids the flat noisy appearance often produced by histogram equalization. This algorithm is based on the intensity-dependent spatial summation (IDS) model purported by Cornsweet and Yellott. The model's initial intent was to demonstrate its ability to replicate certain effects in human vision. Its implementation as an image-enhancement routine has predominantly emphasized its ability to enhance edges in imagery. The model has been modified to produce enhancement not only at edges but throughout the entire image profile. As a comparison to histogram equalization, which collapses some quantilization levels in the process of expanding others, the algorithm largely preserves the original brightness gradations as it expands them. Thus, the shape-from-shading cues so important to the perception of form and contour are preserved. Also, this technique, in most cases, enhance high frequency noise to a far lesser extent than does histogram equalization. GRA

N93-16381*# Spectra Research Systems, Inc., Huntsville, AL. Systems Technology Group.
IRD DROPOUT STUDY Final Report
Jeffrey S. Yalowitz, Michael A. Schroer, and John E. Dickson, Jr. Aug. 1992 140 p
(Contract NAS8-39077)
(NASA-CR-191408; NAS 1.26:191408; SRS-TR92-22) Avail: CASI HC A07/MF A02

This final report describes work performed by SRS Technologies for the NASA Marshall Space Flight Center under Contract NAS8-39077, entitled 'Integrated Receiver-Decoder Dropout Study'. The purpose of the study was to determine causes of signal fading effects on ultra-high-frequency (UHF) range safety transmissions to the Space Shuttle during flyout. Of particular interest were deep fades observed at the External Tank (ET) Integrated Receiver-Decoder (IRD) during the flyout interval between solid rocket booster separation and ET separation. Analytical and simulation methods were employed in this study to assess observations captured in flight telemetry data records. Conclusions based on the study are presented in this report, and recommendations are given for future experimental validation of the results. Author

N93-16408# Oak Ridge National Lab., TN.
REMOTE DRIVING WITH REDUCED BANDWIDTH COMMUNICATION
F. W. DePiero, T. E. Noell, and T. F. Gee Aug. 1992 9 p Presented at the 1992 Space Operations, Applications and Research Conference, Houston, TX, 5-7 Aug. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040639; CONF-9208120-2) Avail: CASI HC A02/MF A01

Oak Ridge National Laboratory has developed a real-time video transmission system for low bandwidth remote operations. The system supports both continuous transmission of video for remote driving and progressive transmission of still images. Inherent in the system design is a spatiotemporal limitation to the effects of channel errors. The average data rate of the system is 64,000 bits/s, a compression of approximately 1000:1 for the black and white National Television Standard Code video. The image quality of the transmissions is maintained at a level that supports teleoperation of a high-mobility multipurpose wheeled vehicle at speeds up to 15 mph on a moguled dirt track. Video compression is achieved by using Laplacian image pyramids and a combination of classical techniques. Certain subbands of the image pyramid are transmitted by using interframe differencing with a periodic refresh to aid in bandwidth reduction. Images are also foveated to concentrate image detail in a steerable region. The system supports dynamic video quality adjustments between frame rate, image detail, and foveation rate. A typical configuration for the system used during driving has a frame rate of approx. 4 Hz, a compression per frame of approx. 125:1, and a resulting latency of less than 1s. DOE

N93-16438# Department of the Navy, Washington, DC.
DUAL WAVEBAND SIGNAL PROCESSING SYSTEM Patent Application
Myron Pauli, inventor (to Navy), John Inderhess, inventor (to Navy), Garry Katz, inventor (to Navy), Doug Faraedrich, inventor (to Navy), and Dan Nordmeyer, inventor (to Navy) 23 Jun. 1992 22 p
(AD-D015493; US-Patent-Appl-SN-903218; Navy-Case-70712) Avail: CASI HC A03/MF A01

A Dual Waveband Signal Processing System (DWSPS) is disclosed for differentiating between an primary target signal and background clutter to detect targets and objects with a particularly unique spectral characteristic. The DWSPS is responsive to a plurality of sensors operating on different wavelengths. The output wavebands of the sensors are filtered by either spatial or temporal high-pass filters, and is processed through a network comprising a series of multipliers, dividers, comparators, and subtractors to obtain the weighted correlation functions or Alpha Coefficients, which, when compared to the input wavebands, produces a filtered or processed output signal of the detected features. Author (GRA)

N93-16459 Department of the Navy, Washington, DC.
PORTABLE RADAR SIMULATOR Patent
Kenneth Aw, inventor (to Navy) 22 Sep. 1992 5 p Filed 5 May 1992
(AD-D015453; US-Patent-5,150,127; US-Patent-Appl-SN-878593; US-Patent-Class-342-169) Avail: US Patent and Trademark Office

A portable radar simulator, when connected to a transmitting means such as a waveguide horn antenna, provides a radar signal to test a radar receiver. The portable radar simulator comprises a tunable oscillator which generates a continuous wave signal in the microwave frequency range with the desired frequency of the signal being selected by an operator. The signal generated by the tunable oscillator is supplied to a microwave switch. The microwave switch receives a control signal provided by a pulse repetition frequency generating circuit and in response to the control signal turns the switch on or off controlling the transmission of the oscillator generated signal to the wave guide horn antenna. The pulse repetition frequency generating circuit which comprises an integrated circuit timer and a monostable multivibrator provides a variable frequency and variable pulse width control signal. The frequency and pulse width of the control signal are, in turn, set by the operator. GRA

N93-16466 Department of the Navy, Washington, DC.
METEOR BURST COMMUNICATION SYSTEM Patent
John E. Bickel, inventor (to Navy) 2 Jun. 1992 12 p Filed 5 Sep. 1991
(AD-D015470; US-Patent-5,119,500; US-Patent-Appl-SN-759091; US-Patent-Class-435-15) Avail: US Patent and Trademark Office

A meteor burst communication network is disclosed that consists of a plurality of meteor burst communication stations that relay radio messages off of meteor burst trails from one station to another. Each station includes an antenna operably coupled to a receiver and transmitter, a display, a message input device, a computer operably connected to the aforementioned equipment, and a clock that provides a time base to the computer. The computer provides instructions to the transmitter and outputs to a display. The program determines if a message has been received by the receiver. If a message has been received, it is stored in the computer memory. The computer then instructs the transmitter to transmit a probing message for a predetermined period of time. If a response to the probing message has been detected by the receiver, the computer directs the transmitter to cease transmitting the probing message, transmit the message, and purge the message from memory after an acknowledgement message is received that the message was received. In cases where the probing message has been transmitted for a period in excess of the predetermined period, the computer directs the transmitter to cease transmitting and purge the message from memory. Messages may also be input into the station through the message input device. GRA

N93-16519 Department of the Navy, Washington, DC.
BROADBAND QUADRIFILAR PHASED ARRAY HELIX Patent
Michael J. Josypenko, inventor (to Navy) 11 Aug. 1992 6 p Filed 17 Oct. 1990
(AD-D015506; US-Patent-5,138,331; US-Patent-Appl-SN-599559; US-Patent-Class-343-895) Avail: US Patent and Trademark Office

A broadband quadrifilar phased array helix antenna is comprised of a pair of bifilar arrays spaced 90 deg on a coaxial fiberglass tube. A 90 deg feed phase exists between the bifilar arrays. Each bifilar array has three elements with the longest element having approximately twice the length of the shortest element and all three elements being of a length to give

good broadband coverage over a specified range with specified shaped patterns being required. A 180 deg feed phase exists between adjacent elements. A number of trimming adjustments to the design of the antenna are presented for obtaining improved performance. GRA

N93-16592# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
TMN: INTRODUCTION AND INTERPRETATION
Aiko Pras 1992 36 p
(Memo-INF-92-40; TIOS-92/16; ETN-92-92451) Copyright Avail: CASI HC A03/MF A01

An overview of Telecommunications Management Network (TMN) status is presented. Its relation with Open System Interconnection (OSI) systems management is given and the commonalities and distinctions are identified. Those aspects that distinguish TMN from OSI management are introduced; TMN's functional and physical architectures and TMN's logical layered architecture are discussed. An analysis of the concepts used by these architectures (reference point, interface, function block, and building block) is given. The use of these concepts to express geographical distribution and functional layering is investigated. This aspect is interesting to understand how OSI management protocols can be used in a TMN environment. A statement regarding applicability of TMN as a model that helps the designers of (management) networks is given. ESA

N93-16679*# Augsburg Coll., Minneapolis, MN.
A CORRELATIVE INVESTIGATION OF THE PROPAGATION OF ULF WAVE POWER THROUGH THE DAYSIDE MAGNETOSPHERE Status Report, 1 Jan. - 30 Jun. 1992
Mark J. Engebretson 30 Jun. 1992 17 p
(Grant NAGw-1567)
(NASA-CR-191809; NAS 1.26:191809) Avail: CASI HC A03/MF A01

Work performed from 1 Jan. - 30 Jun. 1992 is reported. The topics covered include the following: the radial pulsation study, the wave polarization study; radial boundaries of Pc 3-4 pulsations in the dayside magnetosphere; and source regions for correlated ULF-VLF pulsations. Author

N93-16716*# Howard Univ., Washington, DC.
NCC SIMULATION MODEL: SIMULATING THE OPERATIONS OF THE NETWORK CONTROL CENTER, PHASE 2 Progress Report
Norman M. Benjamin, Arthur S. Paul, and Tepper L. Gill 15 Dec. 1992 23 p
(Contract NAG5-995)
(NASA-CR-191616; NAS 1.26:191616) Avail: CASI HC A03/MF A01

The simulation of the network control center (NCC) is in the second phase of development. This phase seeks to further develop the work performed in phase one. Phase one concentrated on the computer systems and interconnecting network. The focus of phase two will be the implementation of the network message dialogues and the resources controlled by the NCC. These resources are requested, initiated, monitored and analyzed via network messages. In the NCC network messages are presented in the form of packets that are routed across the network. These packets are generated, encoded, decoded and processed by the network host processors that generate and service the message traffic on the network that connects these hosts. As a result, the message traffic is used to characterize the work done by the NCC and the connected network. Phase one of the model development represented the NCC as a network of bi-directional single server queues and message generating sources. The generators represented the external segment processors. The served based queues represented the host processors. The NCC model consists of the internal and external processors which generate message traffic on the network that links these hosts. To fully realize the objective of phase two it is necessary to identify and model the processes in each internal processor. These processes live in the operating system of the internal host computers and handle tasks such as high speed message exchanging, ISN and NFE interface, event monitoring, network monitoring, and message logging. Inter process communication is achieved through the operating system facilities. The overall performance of the host is determined by its ability to service messages generated by both internal and external processors. Author

N93-16943*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SCATTERING FROM ARBITRARILY SHAPED MICROSTRIP PATCH ANTENNAS
David G. Shively, Manohar D. Deshpande (Vigyan Research Associates, Inc., Hampton, VA.), and Capers R. Cockrell Dec. 1992 36 p
(DA Proj. 1L1-61102-AH-45; RTOP 505-64-52-60)
(NASA-TP-3291; L-17122; NAS 1.60:3291; CECOM-TR-92-E-5) Avail: CASI HC A03/MF A01

The scattering properties of arbitrarily shaped microstrip patch antennas are examined. The electric field integral equation for a current element on a grounded dielectric slab is developed for a rectangular geometry based on Galerkin's technique with subdomain rooftop basis functions. A shape function is introduced that allows a rectangular grid approximation to the arbitrarily shaped patch. The incident field on the patch is expressed as a function of incidence angle theta(i), phi(i). The resulting system of equations is then solved for the unknown current modes on the patch, and the electromagnetic scattering is calculated for a given angle. Comparisons are made with other calculated results as well as with measurements. Author

N93-17398# Posterijen, Telegrafie en Telefonie, The Hague (Netherlands).
[ACTIVITIES OF THE PTT] Annual Report, 1990 [90 LABORATORIUMACTIVITEITEN]
M. Bolle, J. H. Donker, O. Akkerman, and L. Lueschen 1991 210 p In DUTCH
(ISBN-90-72125-27-4; ETN-92-92541) Copyright Avail: CASI HC A10/MF A03

Laboratory activities of the Netherlands PTT (Post, Telephone, and Telegraph) are reported. Research activities were performed in the field of postal techniques; telecommunication, transportation, and information services; telecommunication infrastructure and provisions; computer supported telephony applications; and specification and programming environment for communication software. ESA

N93-17585# Technische Univ., Delft (Netherlands).
ANALYSIS-BY-SYNTHESIS SPEECH CODING BASED ON RELAXED WAVEFORM-MATCHING CONSTRAINTS Ph.D. Thesis
Willem Bastiaan Kleijn Dec. 1991 172 p
(ETN-92-92529) Avail: CASI HC A08/MF A02

Methods to encode the speech signal at bit rates of around 3000 to 5000 bits/second (b/s) are described. The current status of low bit rate speech coding techniques is discussed with emphasis on issues relevant for the understanding of a class of coders which are referred to as Linear Prediction (LP) based analysis by synthesis coders. Such speech coders are now capable of reconstructing good quality speech from a bit stream with a rate of approximately 5000 b/s. Special fast procedures the CELP (Code Excited LP) algorithm were developed to make implementation on modest hardware possible. A unified description of fast procedures described in the literature and a comparison of their computational and storage requirements is given. The concepts which led to the interpolation of prototype waveforms can also be used to obtain significant improvement in efficiency of LP based analysis by synthesis methods such as CELP. Methods to perform proper interpolation of the LTP parameters are provided. The procedures described have in common a relaxation of the constraints used in existing LP based analysis by synthesis speech coders, which does not affect the perceptual quality of the reconstructed speech. As a result, a speech signal of given perceptual quality can be encoded at lower bit rates. ESA

N93-17632# Helsinki Univ. of Technology, Espoo (Finland).
FAST TRAINING OF A HIGH-SPEED VOICE AND DATA MODEM RECEIVER Ph.D. Thesis, 1991
Risto Kari (Nokia Research Center, Espoo, Finland) Helsinki, Finland Finnish Academy of Technology 1990 163 p
(Acta-Polytec-Scand-EL-67; ISBN-951-666-322-2; ETN-92-92612) Avail: CASI HC A08/MF A02

Fast training of a high speed (up to 19.2 kbits/s) voiceband data modem receiver is studied. Implementation and fast initialization of adaptive equalization, carrier recovery, and timing recovery are discussed. Various start up equalization algorithms are reviewed. It is concluded that the

cyclic start up equalization algorithm based on discrete Fourier transform techniques with fractional tap spacing provides the most economic and efficient method for fast startup equalization in high speed voiceband data modems. It is shown that the performance of the cyclic start up equalization algorithm may be improved by proper modifications. The modified algorithms improve the equalization of severely distorted channels and allow the use of a very short training sequence. Estimation of the carrier frequency offset and fast initialization of the carrier recovery system are discussed. Phase jitter tracking, that is essential on voiceband data modems at rates above 9.6 kbit/s, is studied. A fast method for estimating the phase jitter value is presented. Several algorithms for timing recovery are investigated. It is shown that the amount of timing jitter may be made almost independent of the channel characteristics by estimating the channel group delay at the band edges and modifying the timing recovery algorithms adaptively according to the group delay difference between the Nyquist frequencies. Efficient digital implementation of timing recovery is studied. A modified square algorithm with reduced computational complexity is presented. ESA

N93-17671# Naval Postgraduate School, Monterey, CA.
IMPLEMENTATION OF THE ONE BIT SPECTRAL CORRELATION ALGORITHM M.S. Thesis
George A. Hutcheson Jun. 1992 51 p
(AD-A257748) Avail: CASI HC A04/MF A01

The computational efficiency of the One Bit Spectral Correlation Algorithm is compared to other cyclic spectrum analysis algorithms. A transmission bandwidth advantage is discussed. A parallel computational structure which implements the OBSCA is described and a system architecture is proposed. GRA

N93-17689# Syracuse Univ., NY. Dept. of Electrical and Computer Engineering.
COMPUTER PROGRAM FOR NUMERICAL EVALUATION OF THE PERFORMANCE OF A TM01 CIRCULAR TO TE10 RECTANGULAR WAVEGUIDE MODE CONVERTER Final Report, 25 Aug. 1990 - 24 Aug. 1991
Joseph R. Mautz and Roger F. Harrington Jan. 1992 178 p
(Contract DAAL02-90-K-0027)
(AD-A257694; TR-92-1; HDL-CR-92-027-1) Avail: CASI HC A09/MF A02

Two identical rectangular waveguides are fed by means of two symmetrically placed apertures in a circular waveguide. Power is transmitted from the TMOI mode in the circular waveguide to the TE10 dominant mode in each rectangular waveguide. A computer program for evaluating this power is described and listed.This computer program also evaluates the magnitude of each orthogonal component of the tangential electric field in the apertures. Sample input and output are provided. GRA

N93-17707# Naval Research Lab., Washington, DC.
NON-GAUSSIAN NOISE MODELS AND COHERENT DETECTION OF RADAR TARGETS Interim Report
Kevin J. Sangston and Karl R. Gerlach 5 Nov. 1992 60 p
(AD-A258049; NRL/FR/5341-92-9367) Avail: CASI HC A04/MF A01

The problem of detecting radar targets against a background of coherent, correlated non-Gaussian clutter is studied with a two-step procedure. In the first step, the structure of the multidimensional probability density function (PDF) describing the statistical properties of the clutter is derived. The starting point for this derivation is the basic scattering problem, and the statistics are determined from an extension of the Central Limit Theorem that is formulated and proven herein. Some basic mathematical properties of the resulting distributions are studied, and the problem of fitting data to such distributions is also discussed. The end product of the first step is a multidimensional PDF, which is then used in step 2 in the derivation of both the optimal and a suboptimal detection structure for detecting radar targets in this type of clutter. Performance results for the new detection processor are also given. GRA

N93-17709# Electrospace Systems, Inc., Richardson, TX.
VLF/LF CORONA INVESTIGATION Final Report
A. D. Watt and P. M. Hansen May 1992 58 p
(Contract N66001-88-D-0346)
(AD-A258052; NRAD-TD-2266) Avail: CASI HC A04/MF A01

To determine corona power for given sets of typical conditions, tests were performed at the Forestport, NY, high voltage test facility during 1985 to determine onset conditions, and in 1989 to measure corona power at VLF and LF. A discussion of the results of these tests is presented in this report. GRA

N93-17721# Naval Postgraduate School, Monterey, CA.
ANALYSIS OF CONSTANT PHASE CONTOURS OF EVAPORATION DUCT MODE FUNCTIONS FOR WAVEGUIDE MODE PROPAGATION M.S. Thesis
Jen-Peng Che Sep. 1992 101 p
(AD-A257634) Avail: CASI HC A06/MF A02

The M-Layer program tracks the constant phase lines $Im(D(q)) = 0$ and looks for their intersections with the lines $Re(D(q)) = 0$ for the locations of the zeros of the mode function D(q). These two types of constant phase lines are tracked and plotted over a search region which contains modes having a range attenuation rate of no more than 5 dB per km. Several new parameters for use in mode search are deduced from the results and some old ones are verified. Future studies is waveguide mode propagation theory pertaining to atmospheric ducts may benefit from this work. An improved mode search strategy is also proposed. GRA

N93-17722# Naval Postgraduate School, Monterey, CA.
CODED ORTHOGONAL SIGNALING M.S. Thesis
Salih Semerciler Sep. 1992 47 p
(AD-A257635) Avail: CASI HC A03/MF A01

In this thesis, a new scheme of encoding orthogonal MFSK signals with convolutional codes is proposed. Instead of separating the code and the signals as is done conventionally, here the m outputs of the convolutional encoder of rate k/m are used to select the $M = 2m$ orthogonal FSK signals. This combined coded system is called trellis-coded modulation MFSK (TCM/MFSK). The free distance of TCM/MFSK codes is found computationally. Asymptotic coding gains (ACG) of several TCM/MFSK systems relative to uncoded MFSK systems having the same bandwidth efficiency (bits/s/Hz) are calculated. Both analytic descriptions and natural mapping implementations of TCM/4-FSK with rate 1/2 and TCM/8-FSK with rate 2/3 for several constraint lengths of the convolutional codes are given. The analytic description of TCM/MFSK is also obtained computationally. GRA

N93-15729# Alenia Spazio S.p.A., Rome (Italy). Space Antenna Group.
ORBITAL MANOEUVRE EFFECTS ON LARGE FLEXIBLE ANTENNAE
William Adam, Alberto Bramante, and Alberto Meschini *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 575-577 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-15761# Aerospatiale, Les Mureaux (France). Div. des Systemes Strategiques et Spatiaux.
TELECOM 2 DEPLOYABLE REFLECTORS
A. Noir, J. D. Lefebvre, and D. Coquelet (Bertin et Cie., Plaisir, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 793-798 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15768# Construcciones Aeronauticas S.A., Madrid (Spain). Space Div.
ON THE DYNAMIC QUALIFICATION OF LARGE DEPLOYABLE ANTENNAS
Kimon Alexiou and Pedro Luengo *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 839-846 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15770# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Space Communications and Propulsion Systems Div.
DYNAMIC DEPLOYMENT ANALYSIS OF A MESH ANTENNA REFLECTOR
B. Groeger *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 855-860 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15773# Aerospatiale, Les Mureaux (France). Div. des Systemes Strategiques et Spatiaux.
DYNAMIC OF LARGE REFLECTORS
P. Picard, C. Dauviau, J. D. Lefebvre, C. Garnier (Aerospatiale, Cannes, France), and C. Truchi (Aerospatiale, Cannes, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 877-883 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15777# Maschinenfabrik Augsburg-Nuernberg A.G., Augsburg (Germany).
EXPERIENCES WITH LARGE CFRP-RADIOTELESCOPE REFLECTORS
D. Muser *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 907-911 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-16790*# Kentucky Univ., Lexington. Dept. of Electrical Engineering.
ANTENNA ANALYSIS USING NEURAL NETWORKS
William T. Smith *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 176-177 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17327*# Chicago State Univ., IL. Dept. of Mathematics and Computer Science.
ELECTROMAGNETIC SCATTERING IN CLOUDS
Richard Solakiewicz *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N93-15703# Texas Univ., Austin.
HYDROGEN PEROXIDE AND B-NICOTINAMIDE ADENINE DINUCLEOTIDE SENSING AMPEROMETRIC ELECTRODES BASED ON ELECTRICAL CONNECTION OF HORSERADISH PEROXIDASE REDOX CENTERS TO ELECTRODES THROUGH A THREE-DIMENSIONAL ELECTRON RELAYING POLYMER NETWORK Technical Report, Oct. 1991 - Sep. 1992
Mark Vreeke, Ruben Maidan, and Adam Heller 20 Sep. 1992 43 p
(AD-A256789) Avail: CASI HC A03/MF A01

Hydrogen peroxide is efficiently electroreduced at an electrode modified with a hydrophilic, permeable film of horseradish peroxidase (HRP) covalently bound to a 3-dimensional epoxy network having polyvinyl pyridine (PVP)-complexed Os(bpy)2Cl+3/+2 redox centers. The sensitivity of the resulting H2O2 cathode at O.OV(SCE) is 1A/sq cm/m. Its current increases linearly with H2O2 concentration in the 1x10(-7)M(-)2x10(-4)M range. Related NAD(P)H cathodes are based on stoichiometric homogeneous reduction of O2 to H2O2 by NADH or NAD(P)H. The reduction involves two known steps. In the first step, NAD(P)H transfers two electrons and a proton to a dissolved quinoid. The quinoids are typically derived of phenazines, however phenothiazine and phenoxazine derivatives are also useful. In the second step, two electrons and a proton are transferred from the reduced quinoid to O2. This reaction produces H2O2 and the original quinoid. Because the two reactions are quantitative, the sensitivity and the linear range of the resulting NADH and NADPH electrodes are identical with those of the H2O2 electrode, 1A/sq cm/M and 1x10(-7)M (-2)2x10(-4)M respectively. GRA

N93-15826# Ames Lab., IA.
AC LOSS AND DYNAMIC RESISTANCE OF A HIGH T(SUB c) STRAND CARRYING A DIRECT CURRENT IN A TRANSVERSE AC MAGNETIC FIELD
E. W. Collings (Battelle Columbus Labs., OH.), K. R. Marken (Battelle Columbus Labs., OH.), M. D. Sumption (Battelle Columbus Labs., OH.), J. R. Clem (Iowa State Univ. of Science and Technology, Ames.), S. A. Boggs (Underground Systems, Inc., Armonk, NY.), and M. V. Parish (CPS Superconductors, Inc., Milford, MA.) 1991 16 p Presented at the Cryogenic Engineering Conference and International Cryogenic Materials Conference, Huntsville, AL, 11-14 Jun. 1991
(Contract W-7405-eng-82)
(DE92-040581; IS-M-718; CONF-910635-21) Avail: CASI HC A03/MF A01

A superconducting wire (diameter, d) exposed to an AC longitudinal or transverse magnetic field (amplitude, H(sub m)) experiences a hysteretic power loss, W(sub h). If a DC transport current (density, J) is next applied, extra dissipation is encountered as the current interacts with the moving mixed-state vortices. But if J and H(sub m) are sufficiently small, and J(sub c) and d sufficiently large it is possible for loss-free current to flow down the central core of the wire out of range of the oscillating field. In other words, H(sub m) should be less than some 'penetration value,' H*(J) = H*(1-j), where H* is the usual penetration field and j is equivalent to J/J(sub c). The current-related dissipation, W(sub dyn), can be interpreted as taking place within a dynamic resistivity, rho(sub dyn). Below H*(J) the only dissipation is W(sub h); above it the dissipation is W(sub t) = W(sub h) + W(sub dyn). In the latter regime, as J increases W(sub h) decreases and W(sub dyn), increases. The result is a net increase in W(sub t) during which, as J approaches J(sub c), W(sub h) tends to zero and W(sub dyn) undergoes a smooth transition to the flux-flow (and eventually, normal) state. Some of these predictions were confirmed in a series of studies of dynamic resistivity in two samples of high-(Tc) YBCO strand--a low-J(sub c) braid and a high-J(sub c) monofilament--passing DC transport currents in transverse AC fields with H(sub m)s of up to about 800 gauss. Also described are the results of hysteresis loss measurements, taken at J = 0 using vibrating-sample magnetometry. DOE

N93-15828# Argonne National Lab., IL.
DESIGN ASPECTS OF MID-SIZE SMES USING HIGH TEMPERATURE SUPERCONDUCTORS
S. M. Schoenung, W. R. Meier, J. R. Hull, R. L. Fagaly, M. Heiberger, R. B. Stephens, J. A. Leuer, and R. A. Guzman 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE92-040723; ANL/CP-77105; CONF-920802-6) Avail: CASI HC A01/MF A01

Conceptual designs of modular, cold-supported SMES units using high temperature superconductors (HTS) were investigated over the mid-size energy range of 2 to 200 MWh (7.2 to 720 GJ). This size range covers many utility, industrial, and military applications. Both toroidal and solenoidal configurations were analyzed to determine physical dimensions, heat loads, and cost of major components. Among the effects considered were the impact of critical current density on feasible configurations, mass of conductor, and cost; the effects of magnetic field and strain limits on physical parameters and structural mass; and the savings in refrigeration from operating at high temperature. The design of the HTS conductor, stability criteria, and coolant selection are also discussed. DOE

N93-15856# Lehigh Univ., Bethlehem, PA.
EFFECTS OF PROCESSING ON MOS RADIATION HARDENING Technical Report, 27 Aug. 1988 - 17 Aug. 1992
Ralph J. Jaccodine and Donald R. Young Sep. 1992 43 p
(Contract DNA001-88-C-0122)
(AD-A257361; DNA-TR-92-12) Avail: CASI HC A03/MF A01

This study substantiated the beneficial effects of using fluorine as an additive during the oxidation of silicon for application to Insulated Gate-Field Effect transistor technology. The modern trend towards smaller devices makes it imperative to reduce the time and/or temperature required for the oxidation process. The dramatic increase in oxidation rates resulting from very small fluorine additions suggests the desirability of using fluorine. The results have clearly shown a significant reduction in the strain at the Si-SiO2 interface, and in addition, a reduction in the oxidation enhanced

stacking faults in the silicon. Electrical characterization confirmed the conclusion that the rise of fluorine is beneficial. The results are discussed. A relatively new technique was developed to use Q-V measurements to evaluate the interface and results of these measurements are included. In summary, we are excited about the significant technological improvements that result from the use of fluorine during the oxidation process. GRA

N93-15888# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.

A TIMING ANALYSIS OF LEVEL-CLOCKED CIRCUITRY

Alexander T. Ishii and Charles E. Leiserson Sep. 1992 35 p

(Contracts N00014-91-J-1698; N00014-89-J-1988)

(AD-A256796; MIT/LCS/TR-548) Avail: CASI HC A03/MF A01

An algorithm is presented for verifying proper timing in VLSI circuits where latches are controlled by the levels (high or low) of the controlling clocks rather than the transitions (edges) of the clocks. Such level-clocked circuits are frequently used in MOS VLSI design. A level-clocked circuit is modeled as a graph G = (V, E), where V consists of components-latches and functional elements-and E represents intercomponent connections. The algorithm verifies the proper timing of a circuit in worst-case O(V/E) time and O(V + E) space. Our analysis decouples the problem of generating timing constraints from the problem of efficiently checking them. We show how various base step functions can be used to provide sufficient conditions for a circuit to operate properly, and we provide a new base step function which is less pessimistic than those used in previous timing verifiers, yet correctly handles timing constraints that are cyclic or extend across the boundaries of multiple clock phases or cycles. The base step function is used to derive a computational expansion of the circuit from which a collection of simple linear constraints are derived. These constraints can be efficiently checked using standard graph algorithms. GRA

N93-15891# Johns Hopkins Univ., Baltimore, MD. Dept. of Materials Science and Engineering.

RAPID SILICON DIOXIDE FILM FORMATION ON CLEAN SILICON SURFACES Final Report, Dec. 1988 - 30 Jun. 1991

Jerome Kruger and Gene A. Danko 19 Oct. 1992 182 p

(Contract N00014-89-J-1265)

(AD-A257261) Avail: CASI HC A09/MF A02

Future generations of silicon-based microelectronic circuits will require ever-smaller devices, new classes of devices, and demands for higher reliability, thereby requiring further refinements of silicon planar technology. An understanding of the kinetics of film formation and optical properties of ultrathin silicon dioxide films on a parent silicon substrate is necessary to measure and predict the behavior of such devices. A high-speed ellipsometer and growth chamber were constructed to measure the growth rate of SiO2 on hot silicon substrates from which the prior native oxide had been removed. Data gathered from temperatures between 800 and 1000 C for three substrate orientations (100), (111), and (110) reveal the dependence of the refractive index of SiO2 as a function of oxide thickness. No orientation effects were found. Kinetic measurements reveal two new linear growth regions with activation energies of EI = 0.603 eV and EII = 0.794 eV, respectively. X ray photoelectron spectroscopy provides chemical evidence of oxygen supersaturation and a coesite-like structure near the oxide-substrate interface. The results will provide baseline data necessary for radiation hardening assessments, data to aid the development of the next generation of ellipsometric thin film standards, and will permit process designers to develop thinner device oxides. The instrumentation developed for this work may have commercial applicability for process control feedback and in situ quality assurance. GRA

N93-15901# California Univ., Los Angeles. Dept. of Electrical Engineering.

NONLINEAR CHARACTERISTICS OF SUPERCONDUCTING TRANSMISSION LINES Annual Technical Report, 1 Oct. 1991 - 30 Sep. 1992

Tatsuo Itoh 7 Oct. 1992 5 p

(Contract N00014-91-J-1651)

(AD-A256388) Avail: CASI HC A01/MF A01

It is known that the surface resistivity and the depth of penetration of high Tc superconductors may be dependent on the current density or the surface magnetic field. If a printed transmission line such as a microstrip line is made of these materials, the current distribution in the cross section of the strip can affect the local resistivity. This in turn modifies the current distribution. Hence, this is a nonlinear problem. A modified spectral domain method in combination with the iteration process was developed which can analyze the propagation characteristics of the superconducting planar transmission lines. The spectral domain method was modified in such a way that the position dependent surface resistance is included in the formulation. The current distribution is expressed in terms of Fourier transforms of the subsectional basis functions. For an assumed current distribution, an iteration process is initiated with an assumption that the surface resistance is constant. After the current distribution is obtained, the surface resistance is readjusted and the process continues until convergence is reached. The results indicate very notable difference in two aspects in the current distributions on the strip in comparison to a perfectly conducting strip. First, the singularity of the axial current near the edges is no longer present. Second, the magnitude of transverse current is large by two orders of magnitude than the other one in a perfectly conducting microstrip line. In the area of time domain characterizations, a new effort has been initiated for development of an efficient time domain algorithm for characterizations of high speed pulse propagation in a microwave structure including a passive region and an active and/or nonlinear region. The concept of Diakoptics has been introduced in FDTD environment. In this proposed method, the passive portion of the structure is calculated by FDTD only once and the impulse responses at the ports connected to the active/nonliner segment are used for subsequent numerical processing. GRA

N93-15904# Sandia National Labs., Albuquerque, NM.

TECHNIQUE FOR CURRENT STEP MEASUREMENTS ON THE LOW FIELD METAL OXIDE VARISTOR (MOV)

R. A. Jaramillo Aug. 1992 13 p

(Contract DE-AC04-76DP-00789)

(DE93-000843; SAND-92-1011) Avail: CASI HC A03/MF A01

The low field (E approx. = 2kV/cm) Metal Oxide Varistor (MOV) is a voltage regulation device. This report describes a technique for performing DC characteristic measurements on a MOV. The varistor is in the feedback loop of a high voltage operational amplifier. A current source forces a staircase current waveform through a MOV. An operational amplifier provides the required applied voltage to maintain the desired values of current through the varistor. The current values change at a maximum rate of 33.3 readings per second and a high speed voltmeter measures the varistor voltage. The maximum available current and voltage at present are 5 mA and 10 kV respectively. Examples of its use are with data from the MC3596 and XMC4317. DOE

N93-15906# Naval Surface Warfare Center, Bethesda, MD.

MAGNETIC FLUX-LOAD CURRENT INTERACTIONS IN FERROUS CONDUCTORS Report, Jun. 1988 - Jun. 1992

Michael J. Cannell and Richard A. McConnell Jun. 1992 99 p

(AD-A256632; CDNSWC-PAS-92-27) Avail: CASI HC A05/MF A02

A modeling technique has been developed to account for interactions between load current and magnetic flux in an iron conductor. Such a conductor would be used in the active region of a normally conducting homopolar machine. This approach has been experimentally verified and its application to a real machine demonstrated. Additionally, measurements of the resistivity of steel under the combined effects of magnetic field and current have been conducted. GRA

N93-15909# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.

QUASI-OPTICAL POWER COMBINING OF SOLID STATE MILLIMETER-WAVE SOURCES: A PROPOSAL FOR GRADUATE FELLOWSHIP Final Report, 1 Jul. 1989 - 30 Jun. 1992

Michael B. Steer 3 Sep. 1992 9 p

(Contract DAAL03-89-G-0030)

(AD-A256644; ARO-26699.8-EL) Avail: CASI HC A02/MF A01

The goal of the research reported here was the development of a circuit-based modeling procedure for both the passive and active components of a quasi-optical power combiner. Contributions include the development of a multi-port equivalent circuit of a multi-element quasi-optical power combiner. Excellent agreement with experimental results was obtained. Mount independent techniques were also developed for characterizing two terminal active elements. GRA

N93-15938# Los Alamos National Lab., NM.
LARGE ORBIT GYROKLYSTRON DEVELOPMENT AT LOS ALAMOS
R. M. Stringfield, R. M. Wheat, D. J. Brown, M. V. Fazio, J. Kinross-Wright, B. E. Carlsten, G. Rodenz, R. J. Faehl, and R. F. Hoeberling 1992 4 p Presented at the 16th International LINAC Conference, Ottawa, Ontario, 23-28 Aug. 1992
(Contract W-7405-eng-36)
(DE92-040370; LA-UR-92-2813; CONF-9208109-24) Avail: CASI HC A01/MF A01

We have designed and are testing a large orbit gyroklystron amplifier for 1.3 GHz operation in 65 ns pulses. The ultimate power output goal is 500 MW with a gain in excess of 20 dB. This initial investigation is intended to lay the groundwork for operation at 11.4 GHz for particle accelerator applications, and also at frequencies of up to 35 GHz for other uses. Computational design has been performed with the resonant cavity code MAFIA and the particle in cell codes MERLIN and ISIS. Experimental measurements of the resonator modes were correlated with computational and analytical predictions. Electron beam optics through a magnetic cusp was also studied with ISIS and MERLIN, and verified experimentally, to develop a suitable electron beam trajectory from the diode into the resonator region. Performance tests of a single stage device have begun. The device is intended in its final form to use two resonators separated by an electron beam drift pipe. DOE

N93-15970# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
MODELING OF RADIATION EFFECTS IN CMOS Final Report
Jan. 1992 31 p
(Contract DCA100-87-C-0063)
(AD-A257236; NCS-TIB-92-2) Avail: CASI HC A03/MF A01

In this report, we present the basic analytical MOSFET model which describes both the below and above-threshold regimes of device operation. The description is based on a change control model which uses one unified expression for the effective differential channel capacitance. The model also accounts for series drain and source resistances, velocity saturation in the channel, finite output conductance in the saturation regime, and for the threshold voltage shift due to drain bias induced lowering of the injection barrier between the source and the channel (DIBL). The model parameters, such as the effective channel mobility, the saturation velocity, the source and drain resistances, etc. are extractable from experimental data. This makes the model very suitable for incorporation into out circuit simulator, AIM-Spice. We apply the characterization procedure based on this model to a MOSFET with a quarter micron gate length and obtain excellent agreement with experimental data. The approach developed in this report was also applied for modeling other field effect transistors, such as GaAs Metal Semiconductor Field Effect Transistors and Heterostructure Field Effect Transistors. GRA

N93-15973# Sandia National Labs., Albuquerque, NM.
HTS-BASED SWITCHED FILTER BANKS AND DELAY LINES
J. S. Martens, V. M. Hietala, D. S. Ginley, C. P. Tigges, T. A. Plut, J. K. Truman (CVC Products, Inc., Rochester, NY.), and E. K. Track (Hypress, Inc., Elmsford, NY.) 1992 5 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract DE-AC04-76DP-00789)
(DE92-041146; SAND-92-1914C; CONF-920802-8) Avail: CASI HC A01/MF A01

For communications and a number of other applications, switched filter banks (some channelizers) and switched delay lines (phase shifters) are extremely useful since YBaCuO and TlCaBaCuO filters and delay lines have shown significant performance enhancements over their conventional counterparts. A purely superconducting version of the switched assemblies could result in additional improvements. A thermal switch was developed that provides good isolation and insertion loss with adequate switching times to allow a monolithic approach to the switched lines and filter banks. Filter banks in the 8-11 GHz range were demonstrated with insertion losses less than 1 dB and out-of-band rejection greater than a package-limited 50 dB. Switched delay lines were fabricated with insertion losses less than 0.3 dB/bit and peak phase deviations from linearity of less than 5 degrees over 30 GHz bandwidths. DOE

N93-15975# California Univ., Berkeley. Lawrence Berkeley Lab.
IMPROVEMENT OF THICK a-Si RADIATION DETECTORS BY FIELD PROFILE TAILORING
J. S. Drewery, G. Cho, T. Jing, S. N. Kaplan, A. Mireshghi, V. Perez-Mendez, and D. Wildermuth Apr. 1992 6 p Presented at the Material Research Society Spring Meeting, San Francisco, CA, 27 Apr. - 2 May 1992
(Contract DE-AC03-76SF-00098)
(DE92-041192; LBL-32445; CONF-920402-57) Avail: CASI HC A02/MF A01

Application of thick (approximately 50 microns) a-Si p-i-n diodes as a direct radiation detector for minimum ionizing particles is hampered by the need to apply large bias voltages in order fully to deplete the detecting intrinsic layer, which typically contains 5-10 x 10(exp 14) ionizable dangling bonds per cu cm. By insertion of thin p-type layers at intervals within the intrinsic layer, the required depletion voltage can be reduced by a factor of at least 1/(n+1) where n is the number of layers inserted. This principle is demonstrated for devices approximately 12 microns in thickness. It is shown that electron losses within the p-type layer can be kept to minimum by choice of a low doping concentration for the introduced players. DOE

N93-15981# Virginia Univ., Charlottesville. Dept. of Materials Science and Engineering.
INTEGRATED FUNDAMENTAL RESEARCH ON CURRENT COLLECTION Final Report, Feb. 1989 - Sep. 1992
Doris Kuhlmann-Wilsdorf Oct. 1992 13 p
(Contract DAAA21-89-C-0027)
(AD-A256893; UVA/525234/MSE93/101) Avail: CASI HC A03/MF A01

The aim of our research has been to add to basic understanding in the area of current collection with particular emphasis on topics likely to benefit practical objectives. Under sponsorship of this contract twenty three papers were published in the international literature as listed in the last section. Additionally, thirteen invited lectures and eleven contributed lectures on various aspects of this research were delivered at Universities, Research Laboratories and International Conferences by the Principal Investigator and co-workers. Last not least, development of a novel metal fiber material for sliding electrical contacts has been continued with much success. This is expected to become very useful for making metal fiber brushes for homopolar motors/generators as well as for EML armatures. GRA

N93-15984# Hughes Aircraft Co., Torrance, CA. Electron Dynamics Div.
RF VACUUM MICROELECTRONICS Quarterly Technical Report No. 2, 1 Jul. - 30 Sep. 1992
David S. Komm 30 Sep. 1992 5 p
(Contract MDA972-92-C-0034; ARPA Order 8162)
(AD-A257320) Avail: CASI HC A01/MF A01

Most of mask set 1 was delivered in the previous quarter. In the second quarter (July) we took delivery of the final mask layer and re-ordered one other layer due to problems that we discovered with the original design rules. All of the mask layers were checked for registration and found to be within acceptable limits. We found that all the tip sizes were easily resolved with our standard lithographic techniques. Even 1 micron diameter opening to etch the smallest molds were easily obtained. The key problem that we encountered in using the newly designed mask was poor layer to layer registration of patterns defined prior to plating (on the silicon mold) to patterns defined after plating on the silver substrates. It appears that the dimensional stability of the silver is not as good as a typical semiconductor. As a result, there was about 10 microns of runout per cm when we aligned the gate metal pattern to the tip arrays. This amount of runout is tolerable but unexpected and did result in the loss of some samples due to subsequent emitter to gate shorting. Note that the tips themselves are made with a self-aligned technique and do not require any layer to layer registration; tip geometry was not affected by the problem in layer registration. GRA

N93-15990# Naval Postgraduate School, Monterey, CA.
TEMPERATURE DISTRIBUTION AND THERMALLY INDUCED STRESSES IN ELECTRONIC PACKAGES M.S. Thesis
Andrei Sapsai, Jr. Sep. 1992 104 p
(AD-A257334) Avail: CASI HC A06/MF A02

This investigation is concerned with the steady state temperature and thermally induced stress distributions in electronic packages due to heat generated by the chip. Finite Element codes were employed to solve for

the distribution of temperature and stresses within the package. Four parametric studies were undertaken to determine their effects on system behavior. The material study considered two chip and two solder materials and four substrate materials. Convective heat transfer was varied from 200 through 500 W/M2 C. In the geometric study, chip height to overall height was varied. The effect of package encapsulation was studied. Results are presented for both temperature and stress distributions at the solder interfaces. GRA

N93-16004# Honeywell, Inc., Bloomington, MN. Sensor and System Development Center.

RF VACUUM MICROELECTRONICS Quarterly Research and Development Status Report No. 4, 1 Jul. - 30 Sep. 1992

D. K. Arch 16 Oct. 1992 8 p

(Contract MDA972-91-C-0030)

(AD-A257208) Avail: CASI HC A02/MF A01

We summarize our fourth quarter progress towards developing a thin film edge emitter vacuum triode capable of 1 GHz modulation for sustained (more than 1 hour) periods of time. Current densities of up to 10 uA/um have now been measured on diode structures. Total current emission of 380 mA was measured for a thin film edge emitter diode which is a factor of 25 greater than at the start of the program. A diode array structure was designed to demonstrate the program requirements of 5 mA total current. This array is now in process. The thin film ordered this quarter and the first fabrication run is completed and tested. GRA

N93-16013# Ames Lab., IA.

EVALUATION OF FAST ADC'S

H. B. Crawley, R. McKay, W. T. Meyer, E. I. Rosenberg, and W. D. Thomas 1992 10 p Presented at the 2nd Annual Conference on Electronics for Future Colliders, Chestnut Ridge, NY, 19-21 May 1992

(Contract W-7405-eng-82)

(DE92-040582; IS-M-715; CONF-9205210-2) Avail: CASI HC A02/MF A01

A test bench is described which evaluates the performance of fast analog-to-digital converters over a range of sampling frequencies of 20 to 140 MHz. Test waveforms include DC levels, high purity sine waves, step functions, and triangle waveforms. Significant parameters measured are differential nonlinearity, noise level, number of effective bits, harmonic distortion, maximum slew rate, and word error rate. A program is underway, to compare commercially available 8 and 10 bit devices, with extension to 12 bit devices planned for the near future. Special tests can be arranged and testing of custom devices is possible. DOE

N93-16028# Argonne National Lab., IL.

HIGH-TEMPERATURE SUPERCONDUCTING CURRENT LEADS

J. R. Hull 20 Jul. 1992 20 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992

(Contract W-31-109-eng-38)

(DE92-040729; ANL/CP-76526; CONF-920802-5) Avail: CASI HC A03/MF A01

The use of high-temperature superconductors (HTSs) for current leads to deliver power to devices at liquid helium temperature is near commercial realization. The use of HTSs in this application has the potential to reduce refrigeration requirements and helium boiloff to values significantly lower than the theoretical best achievable with conventional leads. Considerable advantage is achieved by operating these leads with an intermediate temperature heat sink. The HTS part of the lead can be made from pressed and sintered powder. Powder-in-tube fabrication is also possible, however, the normal metal part of the lead acts as a thermal short and cannot provide much stabilization without increasing the refrigeration required. Lead stability favors designs with low current density. Such leads can be manufactured with today's technology, and lower refrigeration results from the same allowable burnout time. Higher current densities result in lower boiloff for the same lead length, but bumout times can be very short. In comparing experiment to theory, the density of helium vapor needs to be accounted for in calculating the expected boiloff. For very low-loss leads, two-dimensional heat transfer and the state of the dewar near the leads may play a dominant role in lead performance. DOE

N93-16030# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.

CENTER FOR HIGH-FREQUENCY MICROELECTRONICS Final Report, 15 Dec. 1986 - 30 Jun. 1992

George Haddad 31 Aug. 1992 228 p

(Contract DAAL03-87-K-0007)

(AD-A257003; ARO-24611.325-EL-UIR) Avail: CASI HC A11/MF A03

By any measure of productivity and impact this program has been highly productive and has had a major impact on III-V semiconductor technology as evidenced by the number of publications, graduate-student output, interactions with Army laboratories, and other D.O.D., industrial and academic laboratories. This program has provided tremendous leverage by enabling us to attract major programs from other federal agencies and industry. It has also enabled us to establish one of the leading facilities and programs in the nation for research in high-frequency microelectronics through major cost-sharing by the University, the State of Michigan and industrial and federal agencies. This program has had and will continue to have a tremendous impact on the field. GRA

N93-16054# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.

PROCEEDINGS OF THE MIT STUDENT WORKSHOP ON VLSI AND PARALLEL SYSTEMS

Charles E. Leiserson 21 Jul. 1992 121 p Workshop held in Dedham, MA, 21 Jul. 1992

(AD-A256795; MIT/LCS/TR-546) Avail: CASI HC A06/MF A02

Some of the topics discussed are as follows: Micron-Scale Display Technology; Virtual Memory for Data-Parallel Computing; The Optimal Synthesis of VLSI Array Architectures from Algorithmic Descriptions; Clay-1: A Distributed Bit-Parallel Computer; Migration in Distributed-Memory Multiprocessor; Frame Memory Management for the Monsoon Processor; Scan-Based Testability for Fault Tolerant Architectures; Serializing Parallel Programs; A Systems Language Compiler for the J-Machine; and The Coprocessor Host Interface Chips. GRA

N93-16078# Naval Academy, Annapolis, MD.

ACTIVE CONTROL OF FOUNDATION TRANSMISSIBILITY USING MAGNETOSTRICTIVE ACTUATORS Final Report, 1991 - 1992

Kenneth E. Poorman 8 May 1992 51 p

(AD-A257135; USNA-TSPR-194) Avail: CASI HC A04/MF A01

The purpose was to determine if vibrations could be actively canceled using a magnetostrictive actuator, a device which applies force when exposed to a magnetic field. The periodic vibrations associated with rotational equipment such as motor-generators were the primary focus. Using acceleration feedback of the foundation only, the magnetostrictive actuators were driven by a filtered signal while being biased with a DC current. The magnitude of vibrations decreased by almost twenty decibels at the resonant frequency. Frequency feedback from the tachometer was added to control an activation threshold. As a result it is predicted that a digital controller would be better suited to active control of rotationally induced vibrations. GRA

N93-16168# RADEX, Inc., Bedford, MA.

THE CRRES MICROELECTRONICS PACKAGE (MEP) DATA PROCESSING SYSTEM

D. S. Reynolds 22 Apr. 1992 30 p

(Contract F19628-90-C-0090)

(AD-A256709; RXR-92041; PL-TR-92-2111; AD-E201216; SR-2) Avail: CASI HC A03/MF A01

Details of the development and operation of the MEP Data Processing System are given, along with a general discussion of the telemetry format. Correlation of MEP data with CRRES ephemeris parameters is described. The creation, maintenance, and utilization of permanent MEP databases are discussed. A variety of sample tables and graphical data presentations are included. GRA

N93-16230# Sandia National Labs., Albuquerque, NM.

INTEGRATED TEST AND PACKAGE METHODS FOR INTEGRATED PHOTONICS

R. F. Carson, S. H. Kravitz, V. M. Hietala, N. E. Harff, M. G. Armendariz, and G. A. Vawter 1992 13 p Presented at the The International Society for Optical Engineering (SPIE) Meeting, Boston, MA, 8-11 Sep.

1992
(Contract DE-AC04-76DP-00789)
(DE93-000748; SAND-92-0650C; CONF-9209184-4) Avail: CASI HC A03/MF A01

Arrangements of discrete photonic waveguide devices are currently being integrated to form circuits. These Photonic Integrated Circuits (PICS) require test methods that are adaptable as circuit size and complexity grows. Here, we describe tests used to characterize a GaAs/GaAlAs waveguide-based PIC being developed for phase-shift control in phased-array antenna applications. The various elements of the PIC include digital and analog waveguide modulators, light-guide splitters and combiners, turning mirrors, and input-output polarization-maintaining single-mode optical fibers. These basic elements are combined to perform higher-order functions such as optical frequency translation (single side-band suppressed carrier modulation), and phase shifting on multiple optical taps. Tests used to characterize the elements include optical loss, guided-wave modal characteristics, antireflection coating effectiveness, electro-optical (phase) modulation efficiency, electrical frequency response, and optical frequency translation. These tests are integrated with the fiber attachment and RF packaging sequence to construct working device prototypes. They are currently being applied to discrete components of the circuit, and will be adapted as the various parts are integrated. DOE

N93-16253# University of Southern California, Los Angeles. Dept. of Electrical Engineering and Electrophysics.
HIGH POWER SWITCHING AND OTHER HIGH POWER DEVICES Final Technical Report, 1 May 1989 - 31 Jul. 1992
Martin Gundersen 30 Sep. 1992 21 p
(Contract DAAL03-89-K-0097)
(AD-A256974; ARO-26257.33-PH) Avail: CASI HC A03/MF A01

High power thyratrons and devices such as high power microwave sources have cathode-related performance limits. Research is described of a simple, robust 'super-emissive' cathode that produces greater than 10,000 A/sq cm from a macroscopic area (approx. 1 sq cm), and operates with a low pressure (approx. 0.1 torr), spatially uniform glow plasma (density greater than 1015 cu cm). The cathode also can operate as a hollow cathode, and is at the heart of the operation of the pseudospark and back-lighted thyratron. The physics of this hollow and super-emissive cathode is very rich. The hollow cathode geometry traps electrons in the hollow cathode backspace. The lifetime of these electrons enables them to ionize a spatially homogeneous high density glow, and this hollow cathode mode of operation is responsible for certain types of electron and ion beam behavior. A plasma cathode sheath that is formed during this phase leads to super-emissive behavior, which is responsible for high current emission. Super-emissive cathode thyratron-type switches (with higher peak current, voltage, di/dt) being developed for pulsed power switching of lasers, accelerators, high current and high coulomb transfer, Marx bank operation, transfer of technology to commercial applications, high current electron beams, and millimeter wave generation (1 to 100 GHz) are described. GRA

N93-16254# Illinois Univ., Urbana.
NATIONAL DEFENSE SCIENCE AND ENGINEERING GRADUATE FELLOWSHIP PROGRAM IN ELECTRICAL ENGINEERING Final Report, 1 Aug. 1989 - 31 Jul. 1992
Otmar S. Schlunk Sep. 1992 4 p
(Contract DAAL03-89-G-0051)
(AD-A256975; ARO-27359.1-EL-NDF) Avail: CASI HC A01/MF A01

Two multiple-access signaling techniques of current interest for mobile communications are broadband code-division multiple-access (CDMA) and narrowband time-division multiple-access (TDMA). This project examined the relationship between signal design and system performance for each of these techniques. System performance for fading, multipath channels was emphasized. Analytical tools were developed for that purpose, and performance was studied for a wide range of system and channel parameters. GRA

N93-16263# IIT Research Inst., Rome, NY.
RELIABILITY ASSESSMENT OF CRITICAL ELECTRONIC COMPONENTS Final Report, Mar. 1989 - Jun. 1992
William K. Denson Jul. 1992 369 p
(Contract F30602-89-C-0062)
(AD-A256996; RL-TR-92-197) Avail: CASI HC A16/MF A03

Failure rate prediction procedures are presented for resistors, capacitors, switches, inductive devices, relays, connectors, interconnection assemblies and rotating devices. Data were collected from military maintenance records, warranty records, published information and field operations to support the model development. The existing failure rate models were examined to identify areas that were deficient and needed to be updated/revised. The objectives were: (1) To reflect current state-of-the-art in part manufacturing technology; (2) Include all part types being used in military systems; (3) Base information on that which is available during design phases; and (4) Be as accurate and precise as possible. The goal of the new model development was to simplify the models in a manner that made their complexity consistent with their precision and accuracy, while at the same time including provisions to account for the primary variable affecting reliability. A new prediction methodology was developed to model the failure rate of devices that exhibit wearout failure mechanisms (i.e., switches, relays, etc.). Additional new part types have been added (i.e., ceramic chip capacitors, tantalum chip capacitors, etc.) which may be included in MIL-HDBK-217E. GRA

N93-16392# Argonne National Lab., IL.
PERFORMANCE MEASUREMENTS OF SUPERCONDUCTING CURRENT LEADS HAVING LOW HELIUM BOILOFF RATES
R. C. Niemann, Y. S. Cha, and J. R. Hull 1992 6 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE92-040730; ANL/CP-75555; CONF-920802-4) Avail: CASI HC A02/MF A01

We have created a performance-measurement facility for current leads as a part of our Laboratory's program to develop applications for high-temperature superconductors. The facility measures the rate of helium vapor boil-off due to current-lead heat input to liquid helium and the pressure drop across a current lead for a pair of leads operating at currents to 100 A. The facility's major components are a liquid-helium dewar having low background heat input; a dewar insert which incorporates the current leads and associated instrumentation or connections for flow, pressure, level, temperature and voltage measurements; and a computer-driven data-acquisition system. The background beat input is small enough so that boiloff rates one-tenth that of an optimized conventional lead can be characterized. The facility has been operated with both conventional; i.e., vapor-cooled copper leads and with leads incorporating high-temperature superconductors at their cold ends. Details of the facility design, construction and operating experiences are presented. DOE

N93-16395# Harry Diamond Labs., Adelphi, MD.
A PRELIMINARY EXAMINATION OF Y 1 (A PROPRIETARY THIN-FILM FERROELECTRIC PRODUCED BY SYMETRIX CORPORATION) Final Report, 1 Mar. - 30 Jun. 1992
Randall A. Moore, Joseph M. Benedetto, Judith T. McCullen, and James M. McGarrity Aug. 1992 22 p
(AD-A255692; HDL-TM-92-17) Avail: CASI HC A03/MF A01

This report presents the results of several tests of the ferroelectric thin film, designated Y1 thin films, which was developed by Symetrix Corporation. The tests include fatigue, at room temperature and 125 C, to greater than 2 x 10 exp 11 power cycles; retention for short periods of time (up to 1000 s) at room temperature and 125 C; retention after fatigue; voltage dependence of retained polarization from 1.5 to 8 V; and write pulse-width dependence of retained polarization from 50 ns to 500 ms. While these tests address critical issues for nonvolatile memory applications, they were limited by a time constraint of one week, and more testing is needed. GRA

N93-16399# Department of the Navy, Washington, DC.
METHOD AND SYSTEM FOR ELECTRON BEAM LITHOGRAPHY Patent Application
E. A. Dobsiz, C. R. Marrian, M. C. Peckerar, and K. W. Rhee, inventors (to Navy) 13 May 1992 21 p
(AD-D015397; US-Patent-Appl-SN-882230) Avail: CASI HC A03/MF A01

This invention pertains to reduction of minimum feature sizes and proximity effects. More specifically, this invention relates to improving

resolution in electronic circuits by reduction or elimination of resist exposure resulting from backscattered, fast secondary, and secondary electrons in high voltage electron beam lithography. GRA

N93-16482 Department of the Navy, Washington, DC.
LOGARITHMIC-PERIODIC MICROWAVE MULTIPLEXER Patent
Christen Rauscher, inventor (to Navy) 31 Mar. 1992 14 p Filed 12 Jun. 1990
(AD-D015475; US-Patent-5,101,181; US-Patent-Appl-SN-536852; US-Patent-Class-333-134) Avail: US Patent and Trademark Office

A multiport microwave multiplexer having components which are log-periodically scaled structures is shown and described. Circuit parameter values and characteristic frequencies are determined and a first output port is linked by a constant ratio to corresponding quantities that define the response of other networks. A capacitively end-coupled channelizer filter is used for each channel of the multiplexer. GRA

N93-16499# Technische Univ., Delft (Netherlands).
ACCURATE AND EFFICIENT LAYOUT EXTRACTION Ph.D. Thesis
Nicolaas Petrus vanderMeijs 1992 152 p
(Contracts EEC-991; FOM-IOP-IC-45-009)
(ISBN-90-9004806-5; ETN-92-92788) Copyright Avail: CASI HC A08/MF A02

Accurate models that reliably predict the electrical behavior of integrated circuits are presented. New techniques to capture effects that were previously not important or for which standard techniques cannot obtain sufficient accuracy are required. The electrical behavior of integrated circuit interconnections is studied. The results show that while interconnect capacitance is important, the classical estimation techniques for it are not sufficiently accurate for state of the art technologies and critical designs. The problem of efficiently handling and manipulating layout data with a view towards layout-to-circuit extraction is considered. A combination of the so called corner stitching data structure and the scanline technique, which achieves an expected case linear time and sublinear space complexity, is developed. The mathematicas and the theoretical background of a boundary element method for accurate computation of the interconnect capacitances of integrated circuits are discussed. Using a new algorithm for approximating the inverse of a matrix, a linear time complexity and a constant space complexity are obtained. An analysis on how the mathematical concepts and tools developed can be implemented in a practical and efficient program is carried out. Algorithms and computational procedures necessary to build a full fledged layout-to-circuit extractor are developed. ESA

N93-16512# California Univ., Berkeley. Lawrence Berkeley Lab.
AMORPHOUS SILICON PIXEL RADIATION DETECTORS AND ASSOCIATED THIN FILM TRANSISTOR ELECTRONICS READOUT
V. Perez-Mendez, G. Cho, J. Drewery, T. Jing, S. N. Kaplan, A. Mireshghi, D. Wildermuth, C. Goodman (Air Techniques Corp., Hicksville, NY.), and I. Fujieda (Nippon Electric Co. Ltd., Tokyo, Japan) Jul. 1992 9 p Presented at the International Conference on Advanced Technology and Particle Physics, Como, Italy, 22-26 Jun. 1992
(Contract DE-AC03-76SF-00098)
(DE92-040379; LBL-32460; CONF-9206222-2) Avail: CASI HC A02/MF A01

We describe the characteristics of thin (1 micron) and thick (greater than 30 micron) hydrogenated amorphous silicon p-i-n diodes which are optimized for detecting and recording the spatial distribution of charged particles, x-ray, gamma rays, and thermal neutrons. For x-ray, gamma ray, and charged particle detection we can use thin p-i-n photosensitive diode arrays coupled to evaporated layers of suitable scintillators. For thermal neutron detection we use thin (2 approximately 5 microns) gadolinium converters on 30 micron thick a-Si:H diodes. For direct detection of minimum ionizing particles and others with high resistance to radiation damage, we use the thick p-i-n diode arrays. Diode and amorphous silicon readouts as well as polysilicon pixel amplifiers are described. DOE

N93-16548# Lawrence Livermore National Lab., CA.
MICROCHANNEL PLATE INTENSIFIER GAIN UNIFORMITY IMPROVEMENT IN SEALED TUBES BY SELECTIVE SCRUBBING
Stan Thomas and Anita Behnke (EG and G Energy Measurements, Inc., Pleasanton, CA.) Aug. 1992 8 p Presented at the 20th International Congress on High Speed Photography and Photonics, Victoria, British Columbia, 25-26 Sep. 1992
(Contract W-7405-eng-48)
(DE92-041082; UCRL-JC-109349; CONF-9209188-4) Avail: CASI HC A02/MF A01

We have improved the gain uniformity of sealed microchannel plate image intensifiers (MCPI's) by selectively scrubbing the high gain sections with a controlled bright light source. The major contributor to poor uniformity on most of the tubes we have tested is the cathode, with the MCP and screen making only minor contributions. Using the premise that ions returning to the cathode from the MCP damage the cathode and reduce its sensitivity, we raster scanned an HeNe laser beam light source across the cathode of an MCPI tube. Cathode current was monitored and when it exceeded a present threshold, the sweep rate was decreased 1000 times, giving 1000 times the exposure to cathode areas with sensitivity greater than the threshold. The threshold was set at the cathode current corresponding to the lowest sensitivity in the active cathode area so that sensitivity of the entire cathode would be reduced to this level. This process reduced tube gain by between 10 and 30 percent in the high gain areas while gain reduction in low gain areas was negligible. Effects on cathode spectral sensitivity and phosphor efficiency, the results of including the MCP in the feedback loop, the possibility of reclaiming tubes damaged by prolonged exposure to resolution targets, and circuit details are discussed. DOE

N93-16590# Oak Ridge National Lab., TN.
INVESTIGATING THERMAL HYDRAULIC QUENCHBACK IN A CABLE-IN-CONDUIT SUPERCONDUCTOR
J. W. Lue, L. Dresner, S. W. Schwenterly, C. T. Wilson, and M. S. Lubell 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040864; CONF-920802-14) Avail: CASI HC A01/MF A01

Quench propagation of a cable-in-conduit force cooled superconductor plays a very important role in the protection of a magnet built with such a conductor as in a Superconducting Magnetic Energy Storage (SMES) system. Some thermal analyses showed that the compressional and frictional heating exerted by the expanding hot helium could heat the helium away from the normal zone above the superconductor current sharing temperature. Thus an acceleration of the quench propagation could be realized. This phenomenon was termed thermal hydraulic quenchback (THQ). A setup has been built specifically to study this phenomenon. The test sample consists of a 50 m long NbTi superconducting cable enclosed in a stainless steel conduit. Heaters 0.2 to 8 m long are provided to quench the conductor. Experimental findings are reported of THQ and its dependence on the initial normal zone length, the conductor current, and the temperature. DOE

N93-16599# Sandia National Labs., Albuquerque, NM.
PHOTOCONDUCTIVE SEMICONDUCTOR SWITCHES FOR HIGH POWER RADIATION
G. M. Loubriel, F. J. Zutavern, G. J. Denison, W. D. Helgeson, D. L. McLaughlin, M. W. OMalley, and J. A. Demarest (Kaman Sciences Corp., Albuquerque, NM.) 1992 10 p Presented at the 4th International Conference on Ultra-Wideband, Short-Pulse Electromagnetics, Brooklyn, NY, 8-10 Oct. 1992
(Contract DE-AC04-76DP-00789)
(DE92-040968; SAND-92-1171C; CONF-9210166-1) Avail: CASI HC A02/MF A01

The results are presented of experiments on Si and GaAs Photoconductive Semiconductor Switches (PCSS). The goal was to improve their performance for high power electromagnetic pulse generation. For Si, ways are shown to alter carrier lifetime achieve higher repetition rates, improvements in switch lifetimes to over 10(exp 7) pulses at high field, and methods that reduce or eliminate thermal runaway and heating. For GaAs, the effects of focused trigger radiation was studied and a further reduction (by a factor of 100) in the required light energy was observed. The gain in these switches is now about 100,000 electrons generated per absorbed or trigger photon. It was further demonstrated that light can be piped through fiber optics to trigger multiple current filaments in GaAs. These results show the ability to control the location of the current filaments. DOE

N93-16608 Department of the Navy, Washington, DC.
OPTICAL HIGH-SPEED PARALLEL BACKPLANE Patent
Albert J. Corda, inventor (to Navy) 28 Jul. 1992 6 p Filed 29 Jan. 1990 Supersedes AD-D014504
(AD-D015505; US-Patent-5,134,508; US-Patent-Appl-SN-471316; US-Patent-Class-359-109) Avail: US Patent and Trademark Office

An optical backplane for use in a high-speed, parallel signal processing system is presented. A plurality of circularly shaped optical conductors are arranged in a cylindrical topology. A plurality of printed circuit card connectors are disposed radially about the perimeter of the optical conductors. Each connector consists of a linear array of optical transceivers. The lens of each optical transceiver is mounted in a socket provided at the perimeter of each optical conductor. The optical transceivers convert electrical data information from printed circuit boards plugged into the circuit card connectors into optical data information. The optical data information propagates throughout the optical conductor, thereby allowing data to be shared by the printed circuit boards. GRA

N93-16616*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A PROTOTYPE AUTOMATIC PHASE COMPENSATION MODULE
John D. Terry Dec. 1992 10 p
(RTOP 307-51-00)
(NASA-TM-105930; E-7441; NAS 1.15:105930) Avail: CASI HC A02/MF A01

The growing demands for high gain and accurate satellite communication systems will necessitate the utilization of large reflector systems. One area of concern of reflector based satellite communication is large scale surface deformations due to thermal effects. These distortions, when present, can degrade the performance of the reflector system appreciable. This performance degradation is manifested by a decrease in peak gain, and increase in sidelobe level, and pointing errors. It is essential to compensate for these distortion effects and to maintain the required system performance in the operating space environment. For this reason the development of a technique to offset the degradation effects is highly desirable. Currently, most research is direct at developing better material for the reflector. These materials have a lower coefficient of linear expansion thereby reducing the surface errors. Alternatively, one can minimize the distortion effects of these large scale errors by adaptive phased array compensation. Adaptive phased array techniques have been studied extensively at NASA and elsewhere. Presented in this paper is a prototype automatic phase compensation module designed and built at NASA Lewis Research Center which is the first stage of development for an adaptive array compensation module. Author

N93-16651# Brookhaven National Lab., Upton, NY.
THE UNOFFICIAL AMPLEX OWNER'S MANUAL
S. D. Coe Aug. 1992 31 p
(Contract DE-AC02-76CH-00016)
(DE93-001437; BNL-47906) Avail: CASI HC A03/MF A01

The AMPLEX chip is an AMPlifying multipLEXing, CMOS technology device. It is an analog signal processor, designed at CERN for use with silicon microstrip detectors. However, its application is not limited to conventional microstrips and it is being used in various detector systems. AMPLEX design goals included modest power consumption and reasonable speed. The main drawback of the chip seems to be a lack of documentation. This report will attempt to fill this void by providing a summary of the properties of the AMPLEX chip, a brief synopsis of how it functions, and most importantly an explanation of how to make it operate in a practical circuit. The information in this paper pertains to the application of the AMPLEX chip to microstrip detectors for the electron beam at Brookhaven National Laboratory's Accelerator Test Facility. Detector design was carried out in the Instrumentation Division. Details of the driving circuit and some information on the inner workings of the AMPLEX chip came directly from CERN and from the paper by E. Beuville et al. The author is in no way connected with CERN, nor is he attempting to promote the AMPLEX chip; he is merely interested in making the chip work and in making it easier for others who might wish the same. Some knowledge of the interior of the chip will help in understanding the process of amplifying and shaping signals, so that is where this paper begins. DOE

N93-16713*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTERIM REPORT ON THE ANALYSIS OF THE MICROWAVE POWER MODULE
Peter Ramins, Raymond W. Palmer, Dale A. Force, Ben T. Ebihara, Robert P. Gruber, and James A. Dayton, Jr. May 1992 14 p
(RTOP 506-72-00)
(NASA-TM-105908; E-7384; NAS 1.15:105908) Avail: CASI HC A03/MF A01

The results of a traveling wave tube multistage depressed collector (TWT-MDC) design study in support of the DARPA/DoD Microwave Power Module (MPM) Program are described. The study stressed the MDC as a key element in obtaining the required high overall efficiencies in the MPM application. The results showed that an efficient MDC, utilizing conventional design and fabrication techniques can be designed for the first generation MPM TWT, which permits a package one wavelength thick (.66 in. at 18 GHz). The overall TWT efficiency goal of 40 percent for electronic countermeasure (ECM) applications appears to be readily achievable. However, the 50 percent goal for radar applications presents a considerable challenge. Author

N93-16756*# Alabama Univ., Huntsville.
ELECTRICAL ACTUATION TECHNOLOGY BRIDGING, VOLUME 1 Final Technical Report, 11 Sep. 1992 - 10 Jan. 1993
Monica S. Hammond and George B. Doane, III 10 Jan. 1993 487 p
(Contract NAS8-38609)
(NASA-CR-191705; NAS 1.26:191705; UAH-5-33057-Vol-1) Avail: CASI HC A21/MF A04

This document contains the proceedings from the conference. The workshop addressed key technologies bridging the entire field of electrical actuation including systems methodology, control electronics, power source systems, reliability, maintainability, and vehicle health management with special emphasis on thrust vector control (TVC) applications on NASA launch vehicles. Speakers were drawn primarily from industry with participation from universities and government. In addition, prototype hardware demonstrations were held at the MSFC Propulsion Laboratory each afternoon. Splinter sessions held on the final day afforded the opportunity to discuss key issues and to provide overall recommendations. Presentations are included in this document. Author

N93-16757*# Alabama Univ., Huntsville.
ELECTRICAL ACTUATION TECHNOLOGY BRIDGING, VOLUME 2 Final Report
1 Oct. 1992 266 p Workshop held in Huntsville, AL, 29 Sep. - 1 Oct. 1992
(Contract NAS8-38609)
(NASA-CR-191706; NAS 1.26:191706) Avail: CASI HC A12/MF A03

The Electrical Actuation (ELA) Bridging Programs integrated ELA and power systems test, and demonstration plans require power output capability which characterizes all power source options for the variety of ELA applications. Acquisition or development of actual power source devices is not practical within ELA-TB Program budget and schedule constraints. The ELA Power Source Systems (ELAPSS) will provide a programmable power source emulation capability to meet all NASA ELA application/system test and demonstration needs. One ELAPSS can be developed to emulate the defined operating characteristics of any power source using commercially available hardware and applications software. A modular design will allow the ELAPSS to be reconfigured to support multiple ELA system sizes, redundancy schemes, and integrated ELA/power system performance and fault testing. The ELAPSS will provide a permanent power source simulator capability for use on current and future NASA programs. The ELAPSS will be a portable piece of NASA GSE for use at any NASA center with the facility to support it. The ELAPSS will be developed with commercial components for more timely development and use, more cost effective replication, and future expansion of power source emulation capability. The ELAPSS allows very robust power degradation and fault testing capability via automated test sequences or manual commands from an operator control console. Various aspects of the program are presented in viewgraph form. Author

N93-16835 Tel-Aviv Univ. (Israel). Dept. of Electronic Communications Control and Computer Systems.

NiCd CELLS BEHAVIOUR AT HIGH CURRENTS AND LOW TEMPERATURE FOR SPACE APPLICATIONS M.S. Thesis

Danny Lahav Apr. 1990 230 p In HEBREW

(ITN-93-85176) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

The relations between the most important parameters of a NiCd battery for low earth orbit (LEO) applications is presented. The relations among these parameters are used to predict the battery capacity and temperature and cycle life; the internal impedance and the state of charge and the temperature. This information is important to the power system design engineer. The study is based on three 7-ampere-hour prismatic NiCd cells cycled at 7.5 C +/- 1 C. The charge method used is Tapering Current with 1.50 V as the end of charge voltage and C/2 maximum charge current. The cycling tests were divided into four groups of about 500 cycles each. A computer simulation program was developed to simulate the battery behavior under working conditions, such as the end of charge voltage, depth of discharge, and charge current. The simulation results are similar to those obtained in the actual cycling tests. The main relations studied were: (1) battery capacity as a function of temperature and number of cycles, (2) internal impedance as a function of temperature and the state of charge, and (3) open-circuit voltage as a function of temperature and state of charge. The battery capacity was found to diminish with the number of cycles, by about 15 percent for the first 660 cycles and about 5 percent for the following 500 cycles. Temperature dependence of the capacity showed a maximum at 15 C. An empirical equation was set up, expressing capacity as a function of temperature and the number of cycles. The internal resistance depended on the state of the charge. The open circuit voltage depended on temperature and number of cycles. Relations between different battery parameters based on different battery tests were established. Knowing these relations enables the prediction of battery performance within the power system. Author (ISA)

N93-17007# Japan Atomic Energy Research Inst., Tokyo.

EXPERIMENTAL INVESTIGATION OF COOLING PERIMETER AND DISTURBANCE LENGTH EFFECT ON STABILITY OF Nb3Sn CABLE-IN-CONDUIT CONDUCTORS

J. R. Armstrong (Massachusetts Inst. of Tech., Cambridge.) Feb. 1992 81 p

(DE92-538568; JAERI-M-92-013) Avail: CASI HC A05/MF A01

The stability of three coils, with similar parameters besides having differing strand diameters, was investigated experimentally using inductive heaters to input disturbances. One of the coils stability was also tested by doubling the inductive heated disturbance length to 10 cm. By computationally deriving approximate inductive heater input energy at 12 T, stability curves show fair agreement with zero-dimensional and one-dimensional computer predictions. Quench velocity and limiting currents also show good agreement with earlier work. Also, the stability measured on one of the coils below its limiting current by disturbing a 10 cm length of conductor was much less than the same samples stability using a 5 cm disturbance length. DOE

N93-17086# Idaho Univ., Moscow. Dept. of Chemical Engineering.

DROP OSCILLATION AND MASS TRANSFER IN ALTERNATING ELECTRIC FIELDS

T. E. Carleson 24 Jun. 1992 7 p

(Contract DE-FG07-86ER-13572)

(DE93-003595; DOE/ER-13572/5) Avail: CASI HC A02/MF A01

In certain cases, droplet direct contact heat transfer rates can be significantly enhanced by the application of an alternating electric field. This field can produce shape oscillations in a droplet which will enhance mixing. The theoretical evaluation of the effect of the interaction of the field with drop charge on the hydrodynamics has been completed for small amplitude oscillations. Previous work with a zero order perturbation method was followed up with a first order perturbation method to evaluate the effect of drop distortion on drop charge and field distribution. The first order perturbation results show secondary drop oscillations of four modes and two frequencies in each mode. The most significant secondary oscillation has the same mode and frequency as the second mode oscillation predicted from the first order perturbation work. The resonant frequency of all oscillations decrease with increasing electric field strength and drop charge. Work is currently underway to evaluate the heat transfer enhancement from an applied alternating electric field. DOE

N93-17188# Sandia National Labs., Albuquerque, NM.

THE USE OF THE CHARGE-INDUCED VOLTAGE ALTERATION TECHNIQUE TO ANALYZE PRECURSORS TO DIELECTRIC BREAKDOWN

D. L. Barton and E. I. Cole, Jr. 1992 12 p Presented at the Microelectronic Processing, San Jose, CA, 21-25 Sep. 1992

(Contract DE-AC04-76DP-00789)

(DE92-040960; SAND-92-0462C; CONF-920971-1) Avail: CASI HC A03/MF A01

Charge-Induced Voltage Alteration (CIVA) is a new scanning electron microscopy technique to rapidly localize open conductors on integrated circuits (IC's). CIVA uses a constant current source to power the IC under test and produces an image by monitoring the variation in voltage supplied to the IC as a function of electron beam position. This concept of observing supply voltage changes as in CIVA has been applied to Tunneling Current Microscopy (TCM). TCM has been used to localize oxide defects in biased, large area MOS capacitors before oxide breakdown by measuring the fluctuations in current with electron beam position. These changes are normally on the order of 10 nA. Conventional current amplifiers normally limit the applied voltage thereby reducing the operational range of the TCM technique unless special circuit modifications are employed. By using a constant current source and monitoring the voltage changes across the capacitor being analyzed, there are no voltage limitations. Signal magnitudes on the order of 5 mV have been recorded from capacitor defects using the CIVA setup. A detailed description of the CIVA acquisition system used for TCM and a comparison with conventional TCM are provided. Images of oxide defects before breakdown are presented to show that, while the two approaches are comparable and each has its own strengths and weaknesses, the CIVA approach is a superior technique for precursor localization. DOE

N93-17210# Sandia National Labs., Albuquerque, NM.

FLUX FLOW MICROELECTRONICS

J. S. Martens, V. M. Hietala, T. A. Plut, D. S. Ginley, G. A. Vawter, C. P. Tigges, M. P. Siegal, J. M. Phillips, and S. Y. Hou 1992 8 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992

(Contract DE-AC04-76DP-00789)

(DE93-000756; SAND-92-1913C; CONF-920802-24) Avail: CASI HC A02/MF A01

Flux-flow based devices such as the superconducting flux flow transistor and magnetically controlled long junctions have been made from thin films of TlCaBaCuO and YBaCuO. The devices are based on the magnetic control of flux flow in their respective structures: a long junction or an array of weak links. The equivalent circuits of the two devices are similar: a low impedance input control line, an output impedance of 3 - 20 ohm and an active current-controlled element. The long junctions have tended to be slower, have lower gain and be somewhat less noisy than their counterparts. The performance of circuits such as narrowband and distributed amplifiers (50 GHz bandwidths, noise figures less than 3 dB), phase shifters (continuous with less than 2 dB loss 4 - 40 GHz), logic gates (2 - 3 ps gate delays) and memories made using these devices will be compared and analyzed. DOE

N93-17274*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

HIGH ENERGY AND HIGH POWER DENSITY ULTRACAPACITORS AND SUPERCAPACITORS Patent Application

Carol R. Lewis, inventor (to NASA) and Shiao-Ping S. Yen, inventor (to NASA) 29 Sep. 1992 24 p

(NASA-Case-NPO-18568-1-CU; NAS 1.71:NPO-18568-1-CU;

US-Patent-Appl-SN-953391) Avail: CASI HC A03/MF A01

Ultracapacitor and supercapacitor designs wherein two discrete metal film current collectors of the prior art, one for each of the cathode and anode, are replaced by a single thin polymer film. The polymer film is typically several microns thick and metallized on both sides. The thickness of the metallization is varied from several hundred to several thousand Angstroms depending upon the particular application. This metallization serves as the positive and negative electrodes (current collectors) which are spatially separated by the polymer dielectric film. The resulting reduction of volume increases the volumetric energy density and the reduction of

mass increases the gravimetric energy density. The electrolyte solvent/salt system can be selected to provide useful individual cell voltages as high as 5 volts. The voltage is limited only by the electrolytic stability of the solvent and salt. Ultracapacitors fabricated in accordance with the present invention may have energy densities exceeding 10 watt-hours per kilogram and volumetric energy densities exceeding 15 watt-hours per liter. Values which are yet higher are feasible with supercapacitors fabricated in accordance with the present invention. NASA

N93-17277*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ENHANCED FATIGUE AND RETENTION IN FERROELECTRIC THIN FILM MEMORY CAPACITORS BY POST-TOP ELECTRODE ANNEAL TREATMENT Patent Application
Sarita Thakoor, inventor (to NASA) 20 Oct. 1992 23 p
(NASA-Case-NPO-18551-1-CU; NAS 1.71:NPO-18551-1-CU; US-Patent-Appl-SN-963974) Avail: CASI HC A03/MF A01

Thin film ferroelectric capacitors comprising a ferroelectric film sandwiched between electrodes for nonvolatile memory operations are rendered more stable by subjecting the capacitors to an anneal following deposition of the top electrode. The anneal is done so as to form the interface between the ferroelectric film and the top electrode. Heating in an air oven, laser annealing, or electron bombardment may be used to form the interface. Heating in an air oven is done at a temperature at least equal to the crystallization temperature of the ferroelectric film. Where the ferroelectric film comprises lead zirconate titanate, annealing is done at about 550 to 600 C for about 10 to 15 minutes. The formation treatment reduces the magnitude of charge associated with the nonswitching pulse in the thin film ferroelectric capacitors. Reduction of this charge leads to significantly more stable nonvolatile memory operations in both digital and analog memory devices. The formation treatment also reduces the ratio of change of the charge associated with the nonswitching pulse as a function of retention time. These improved memory devices exhibit greater performance in retention and reduced fatigue in memory arrays. NASA

N93-17278*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ANODE FOR RECHARGEABLE AMBIENT TEMPERATURE LITHIUM CELLS Patent Application
Chen-Kuo Huang, inventor (to NASA), Subbarao Surampudi, inventor (to NASA), Alan I. Attia, inventor (to NASA), and Gerald Halpert, inventor (to NASA) 13 Oct. 1992 15 p
(NASA-Case-NPO-18580-1-CU; NAS 1.71:NPO-18580-1-CU; US-Patent-Appl-SN-959858) Avail: CASI HC A03/MF A01

An ambient room temperature, high density, rechargeable lithium battery includes a Li(x)Mg2Si negative anode which intercalates lithium to form a single crystalline phase when x is up to 1.0 and an amorphous phase when x is from 1 to 2.0. The electrode has good reversibility and mechanical strength after cycling. NASA

N93-17353# Sandia National Labs., Albuquerque, NM.
HIGH EFFICIENCY UHF OSCILLATOR FOR PORTABLE BATTERY-POWERED APPLICATIONS
K. O. Wessendorf 1992 8 p Presented at the 14th Piezoelectric Devices Conference, Kansas City, MO, 15-17 Sep. 1992
(Contract DE-AC04-76DP-00789)
(DE92-040961; SAND-92-1793C; CONF-9209232-1) Avail: CASI HC A02/MF A01

There is a growing demand for high-frequency circuit designs which are capable of being used in portable battery-powered applications. This type of environment typically requires circuits designed for small size and minimum dc current draw. A transponder design at Sandia National Laboratories required a 430 MHz oscillator (crystal controlled) which could run off a 3 V lithium battery and have an output power of approximately 0 dbm and draw the least possible dc current (less than 4 mA was desired). Physically the oscillator height has to be less than 0.1 sq in. and occupy less than 1 sq in. surface area. Another requirement, for the first engineering prototype, was that the oscillator be made out of inexpensive, standard parts. The design was integrated onto a circuit board with the associated transponder circuitry. This paper describes a technique to make a high-efficiency 430 MHz oscillator which demonstrates efficiencies in the 10 to 12 percent range for an output of approximately 0 dbm. Data will show the frequency spectrum of the oscillator waveform and the performance of the oscillator over temperature and power supply voltage. To meet the requirements and make the design as simple as possible a 107.5 MHz (R(sub m) less than 70 ohms) Statek AT-Strip resonator was chosen. This resonator was chosen because of its small size, surface mountability, and good electrical performance. This resonator was used at series resonance in an oscillator multiplier circuit which would provide a (4X) multiplication in an efficient manner. The oscillator (first stage) is a Butler Oscillator-Multiplier (2X) which is direct coupled to a buffer transistor (second stage) and harmonic generating (2X) transistor which share bias current. The final design delivers 1 dbm at 3 V with 3.33 mA current draw. All harmonics and subharmonics are greater than 20 db down from the desired frequency. DOE

N93-17380# Los Alamos National Lab., NM.
POWER COUPLER AND COLD WINDOW FOR SEVEN-CELL SUPERCONDUCTING CAVITY VERTICAL TESTS
E. R. Gray and G. Spalek 1992 4 p Presented at the 16th International LINAC Conference, Ottawa, Ontario, 23-28 Aug. 1992
(Contract W-7405-eng-36)
(DE93-000791; LA-UR-92-2720; CONF-9208109-63) Avail: CASI HC A01/MF A01

For tests of the LANL 805 MHz seven cell superconducting cavity, we are developing a variable coaxial rf power coupler. Its Q(sub ext) will be variable over a range from 10(exp 5) to 10(exp 12). It will operate nominally at 3kW CW and 100 kW peak for high power processing. The coupler consists of a 3 inch driveline and window, a 3.45 inch T supported by a lambda/4 shorted stub followed by a step transition to a 2 inch coupler port. An approximately 6.6 Ohm impedance choke joint located at the step transition allows the large center conductor travel necessary for the Q(sub ext) variation. The folded choke joint is located at a standing wave current node to keep its excitation below the multipacting level even at high power levels. A low contact-pressure sliding rf seal prevents arcing at the choke joints current node during its filling time. DOE

N93-17393# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
BIPOLAR CURRENT SOURCES FOR THE CORRECTION MAGNETS OF AmPS [BIPOLAIRE STROOMBRONNEN VOOR DE CORRECTIEMAGNETEN VAN AMPS]
J. T. vanEs, G. Luigjes, and J. H. vanTrigt 1992 29 p In DUTCH Revised
(DIGEL-1992-2-Rev; ETN-92-92394) Avail: CASI HC A03/MF A01

A modular bipolar current source system for the 80 correction magnets of the AmPS (Amsterdam Pulse Stretcher) was developed. The current can be continuously adjusted between -3 and +3 A, and is stable within 0.1 percent. The copper resistance of the magnet coils and their wiring is smaller than 8 ohms and the self inductance is 200 mH. The developed system is modular and has a Bitbus control. ESA

N93-17395# Technische Univ., Delft (Netherlands).
OPTIMAL DYNAMIC RANGE INTEGRATED CONTINUOUS-TIME FILTERS Ph.D. Thesis
Gert Groenewold 1992 179 p Sponsored by Netherlands Innovative Research Projects
(ISBN-90-6275-755-3; ETN-92-92524) Copyright Avail: CASI HC A09/MF A02

The fundamental limits to the dynamic range of integrated analog filters are considered, and how these limits can be reached or approximated is addressed. The dynamic range of integrated analog filters depends on the filter network and on the integrators that serve as building blocks in the network. The dependence of the dynamic range on the filter network was explored. The network dependent fundamental limits were disclosed. These limits are dependent on the maximal signal levels, the total capacitance, and the filter transfer function. It was proven that the dynamic range of a bandpass filter is inversely proportional to the quality factor of this filter. A design example of a filter with a close to optimal network was given. With the theories that were developed for integrators and networks, two dynamic range limits for integrated analog filters were formulated: one limit in terms of supply voltages, the available amount of capacitance, and the filter transfer function and the other in terms of the supply power and the transfer function. The dependence of the dynamic range on the capacitance implies a dependence on the chip area. These limits can be used to determine the realizability of integrated analog filters for a certain

application in the very first design stage. The sensitivity of the transfer function to the filter parameters was considered. It was shown that there are links between the sensitivity and the dynamic range, and that a dynamic range optimal filter is close to sensitivity optimal. ESA

N93-17465# Sandia National Labs., Albuquerque, NM.
DURABILITY OF CARBON-PLASTIC ELECTRODES FOR ZINC/BROMINE STORAGE BATTERIES
C. Arnold, Jr. Oct. 1992 25 p
(Contract DE-AC04-76DP-00789)
(DE93-003224; SAND-92-1611) Avail: CASI HC A03/MF A01

In previous work, failure of early versions of the zinc/bromine battery was traced to degradation and warpage of the carbon-plastic electrode. These electrodes were fabricated from copolymers of ethylene and propylene (EP) containing structures that were found to be susceptible to degradation by the electrolyte. In this work, we evaluated two developmental electrodes from Johnson Controls Battery Group, Inc., in which the EP copolymer was replaced with a high-density polyethylene (HDPE) that contained glass-fiber reinforcing fillers. The glass fiber content of these two electrodes was different (19 vs. 31 percent). We determined the effect of electrolyte on sorption behavior, dimensional stability, chemical stability, and thermal, mechanical, and electrical properties under real-time and accelerated aging conditions. We also characterized unaged samples of both electrodes to determine their chemical composition and physical structure. We found that high glass content in the electrode minimizes sorption and increases dimensional stability. Both high and low glass content electrodes were found to be chemically and thermally stable toward the electrolyte. A slight decrease in the storage modulus (G') of both electrodes was attributed to sorption of non-ionic and hydrophobic ingredients in the electrolyte. The electrical conductivity of both electrodes appeared to improve (increase) upon exposure to the electrolyte. No time or temperature trends were observed for the chemical, thermal, or mechanical properties of electrodes made from HDPE. Since decreases in these properties were noted for electrodes made from EP copolymers under similar conditions, it appears that the HDPE-based electrodes have superior long-term stability in the ZnBr2 environment. DOE

N93-17628# Institut National Polytechnique, Grenoble (France). Lab. Conception de Systemes Integres.
GENERATION OF INTEGRATED CIRCUIT TESTS BASED ON FUNCTIONAL MODELS Ph.D. Thesis [GENERATION DE TEST DE CIRCUITS INTEGRES FONDEE SUR DES MODELES FONCTIONNELS]
Margot Karam 1991 187 p In FRENCH
(ETN-92-92674) Avail: CASI HC A09/MF A02

The use of functional models to test complex integrated circuits is investigated. The test generation is performed for finite state machines using the specification used for synthesis. A first phase consists of going through all the arcs of the control graph while optimizing the values of the don't care inputs. The quality of the sequences is shown to be high. The residual faults are detected using the models. Hierarchical test generation is addressed. Local test vectors for blocks are justified to the primary inputs and the fault effects are propagated to the primary outputs using symbolic test values and the functional models for the forward and backward propagation. An original concept of delayed propagations is proposed to reduce the propagation failures. ESA

N93-17641# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
CHARGE-INDUCED STRUCTURAL RELAXATION IN AMORPHOUS SEMICONDUCTORS
Gerhard Mueller 1989 12 p Repr. from Philosophical Magazine B, v. 63, no. 2, 1991 p 465-475
(MBB-Z-0265-89-PUB; ETN-92-92743) Avail: CASI HC A03/MF A01

The concept of charge induced bond breaking, introduced earlier for the treatment of defects in amorphous Si:H is extended to lone pair materials. It is shown that, in both classes of materials, band tail localized charge carriers can give rise to local coordination changes which are consistent with the generalized 8-N rule given by Street. It is shown that these charge driven coordination changes are able to account for the common features of both classes such as the insensitivity to doping, the occurrence of photoinduced effects, and an increasing defect density with decreasing mobility gap. Differences arise on a more quantitative scale in that the relaxation reactions in lone pair materials are more exothermic than those in tetrahedrally coordinated materials. ESA

N93-17682# Honeywell, Inc., Bloomington, MN. Sensor and System Development Center.
RF VACUUM MICROELECTRONICS Quarterly Technical Report, 1 Jul. - 30 Sep. 1992
A. I. Akinwande, P. Bauhahn, B. Speldrich, and D. Arch 29 Oct. 1992 40 p
(Contract MDA972-91-C-0030; ARPA Order 8162)
(AD-A257684) Avail: CASI HC A03/MF A01

We summarize our fourth quarter and discuss fifth quarter plans for the development of an edge emitter based vacuum triode with performance goals of 10 micro-A/micro-m emission current density at less than 250 V and which can be modulated at 1 GHz for 1 hour. Fabrication of two more process runs of field emitter diodes were completed. Current densities of up to 10 micro-A/micro-m have now been measured on diode edge emitters. Total current emission of 380 micro-A was measured for a thin film edge emitter diode which is a factor of 25 greater than at the start of the program. Based on these results we have designed a diode array structure to achieve the 5 mA total current program requirements. The first fabrication run of this array is completed and now in test. The first fabrication run of the edge emitter vacuum triode was completed this quarter and is also in test. Equivalent circuit and FEM modeling of the vacuum edge emitter triode indicates that we should achieve 1 GHz modulation with gain with the present devices and that the device is mechanically stable. GRA

N93-17685# Harris Corp., Melbourne, FL. Government Information Systems Div.
SCAN-BASED SWITCHING TESTS Final Report
Larry D. Bashaw and Ted H. Vriezen Jul. 1992 69 p
(Contract F30602-90-D-0006)
(AD-A257712; RL-TR-92-199) Avail: CASI HC A04/MF A01

This report describes an algorithm for generating scan-based switching tests. The only design consideration required by this algorithm, besides the scan design is the capability to execute two functional clocks with a desired interval between logic scans. The algorithm generates a test vector which is scanned in to cause the source register of the delay path to toggle on the first clock, and captures a transition at the output register of the delay path on the second clock. The algorithm also identifies paths that are not testable, and identifies the points of conflict. GRA

N93-17696# Varian Associates, Palo Alto, CA.
HIGH TEMPERATURE SUPERCONDUCTIVITY Quarterly Report, period ending 30 Jun. 1992
James N. Eckstein 11 Sep. 1992 3 p
(Contract N00014-88-C-0760)
(AD-A257789) Avail: CASI HC A01/MF A01

The overall goals of this program are to develop the technology of Molecular Beam Epitaxy (MBE) growth of High Temperature Superconductivity (HTSC) material, to optimize the performance of HTSC films with high transition temperatures and critical current densities, and to explore the development of electronic devices based on such material. Engineered samples used to study trilayer transport are being grown. The films have large defect free regions and transition temperatures in excess of 80 K. This period we demonstrated that improved control over material growth parameters leads to improved uniformity of Josephson junction critical current density. GRA

N93-17699# Northeastern Univ., Boston, MA.
EM PROPERTIES OF HIGH Tc SUPERCONDUCTORS Final Report, Jun. 1990 - Jun. 1991
S. Sridhar Jun. 1992 13 p
(Contract F30602-88-D-0028)
(AD-A257724; RL-RT-92-179) Avail: CASI HC A03/MF A01

The aim of this contract was to study the factors influencing microwave properties of high Tc superconductors, via fundamental measurements on high quality thin film and single crystal materials. Two principal lines of investigation were pursued: in single crystals of YBa2CU3O(7-6) (Tc=93 K) ultrasensitive RF methods were used to study the penetration depth A, lower critical fields H sub c1 and vortex pinning forces. The penetration

depth and surface resistance were found to obey temperature dependences in good agreement with BCS calculations. The anisotropy and temperature dependence of H sub c1 were measured and also found to be in good agreement with BCS theory. The pinning forces were measured, and the results imply that in good quality single crystals, the pinning is due to core pinning by defects, and implies intrinsic critical currents 2 x 10 exp 7 A/sq. cm. GRA

N93-17749# California Univ., Los Angeles. Dept. of Electrical Engineering.
WAFER SCALE UNION Final Report, 1 Apr. 1989 - 31 May 1992
Harold Fetterman 31 May 1992 136 p
(Contract F49620-89-C-0056)
(AD-A258001; AFOSR-92-0924TR) Avail: CASI HC A07/MF A02

The program we have completed will be discussed in three basic sections. The first will deal with the important developments in optically controlled generation of millimeter waves. This work started from earlier results of mixing high frequencies internally using FETs and HEMTs. In this study, these initial experiments were successfully extended to radiating systems in free space to using new HBTs and semiconductor laser. Section (B) will deal with our advanced picosecond measurements and HEMTs, HBTs and Hot Electron Transistors. It will also present our measurements of bandwidths of channel guides on wafer using our mixing and picosecond techniques. Finally, in section (C), we discuss the new Quantum Well IMPatt, polymer modulators, optical guide developments and InSb devices. Many of these new concepts are just becoming experiment. The overall view of integration is discussed in this third section. GRA

N93-17750# Harry Diamond Labs., Adelphi, MD.
PRELIMINARY INVESTIGATION INTO THE DEVELOPMENT OF HARDENING DEVICES USING VACUUM MICROELECTRONIC TECHNOLOGY Progress Report, Mar. - Sep. 1992
Chance M. Glenn Sep. 1992 18 p
(AD-A258009; HDL-PR-92-40) Avail: CASI HC A03/MF A01

Recently there has been a resurgence of interest in the vacuum valve. Manufacturing capabilities in the area of semiconductor microelectronic devices have paved the way for the emergence of vacuum microelectronic (VME) technology. The possibility of these new devices becoming a robust, high-speed alternative to solid-state electronics has caught the interest of the system hardening community. The most fundamental question asked is whether or not these field emission devices can be incorporated into electronic systems as limiters--the most basic hardening device for in-band front-door hardening. This investigation shows that not only is it possible for these devices to be developed into an alternative to conventional semiconductor limiters, but there may also be marked operational advantages. GRA

N93-15754# Aerospatiale, Bordeaux (France).
DAMAGE TOLERANCE CHECKING ON Ni/H2 BATTERY CELLS
J. L. Dodelin, B. Journet (Aerospatiale, Suresnes, France), M. Kornmann (Battelle Europe, Geneva, Switzerland), D. Paugam (Societe des Accumulateurs Fixes et de Traction, Romainville, France), and L. Perret (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 749-753 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-17287*# Armstrong State Coll., Savannah, GA. Dept. of Computer Science.
A SECOND GENERATION EXPERT SYSTEM FOR CHECKING AND DIAGNOSING AXAF'S ELECTRIC POWER SYSTEM
Alex Bykat *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17317*# Naval Postgraduate School, Monterey, CA. Dept. of Physics.
ON THE CONSEQUENCES OF BI-MAXWELLIAN PLASMA DISTRIBUTIONS FOR PARALLEL ELECTRIC FIELDS
Richard C. Olsen *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N93-15792*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CENTER FOR MODELING OF TURBULENCE AND TRANSITION (CMOTT): RESEARCH BRIEFS, 1992 Progress Reports, May 1991 - May 1992
William W. Liou, ed. and comp. Sep. 1992 190 p
(RTOP 505-62-21)
(NASA-TM-105834; E-7274; NAS 1.15:105834; ICOMP-92-12; CMOTT-92-08) Avail: CASI HC A09/MF A02

The progress is reported of the Center for Modeling of Turbulence and Transition (CMOTT). The main objective of the CMOTT is to develop, validate and implement the turbulence and transition models for practical engineering flows. The flows of interest are three-dimensional, incompressible and compressible flows with chemical reaction. The research covers two-equation (e.g., k-e) and algebraic Reynolds-stress models, second moment closure models, probability density function (pdf) models, Renormalization Group Theory (RNG), Large Eddy Simulation (LES) and Direct Numerical Simulation (DNS). For individual titles, see N93-15793 through N93-15802.

N93-15793*# Sverdrup Technology, Inc., Brook Park, OH.
LUMLEY'S ENERGY CASCADE DISSIPATION RATE MODEL FOR BOUNDARY-FREE TURBULENT SHEAR FLOWS
B. S. Duncan *In* NASA. Lewis Research Center, Center for Modeling of Turbulence and Transition (CMOTT): Research Briefs, 1992 Sep. 1992 p 1-16 (For primary document see N93-15792 05-34)
Avail: CASI HC A03/MF A02

True dissipation occurs mainly at the highest wavenumbers where the eddy sizes are comparatively small. These high wavenumbers receive their energy through the spectral cascade of energy starting with the largest eddies spilling energy into the smaller eddies, passing through each wavenumber until it is dissipated at the microscopic scale. However, a small percentage of the energy does not spill continuously through the cascade but is instantly passed to the higher wavenumbers. Consequently, the smallest eddies receive a certain amount of energy almost immediately. As the spectral energy cascade continues, the highest wavenumber needs a certain time to receive all the energy which has been transferred from the largest eddies. As such, there is a time delay, of the order of tau, between the generation of energy by the largest eddies and the eventual dissipation of this energy. For equilibrium turbulence at high Reynolds numbers, there is a wide range where energy is neither produced by the large eddies nor dissipated by viscosity, but is conserved and passed from wavenumber to higher wavenumbers. The rate at which energy cascades from one wavenumber to another is proportional to the energy contained within that wavenumber. This rate is constant and has been used in the past as a dissipation rate of turbulent kinetic energy. However, this is true only in steady, equilibrium turbulence. Most dissipation models contend that the production of dissipation is proportional to the production of energy and that the destruction of dissipation is proportional to the destruction of energy. In essence, these models state that the change in the dissipation rate is proportional to the change in the kinetic energy. This assumption is obviously incorrect for the case where there is no production of turbulent energy, yet energy continues to cascade from large to small eddies. If the time lag between the onset on the energy cascade to the destruction of energy at the microscale can be modeled, then there will be a better representation of the dissipation process. Development of an energy cascade time scale equation is discussed. Author

N93-15794*# Sverdrup Technology, Inc., Brook Park, OH.
PDF TURBULENCE MODELING AND DNS
A. T. Hsu *In* NASA. Lewis Research Center, Center for Modeling of Turbulence and Transition (CMOTT): Research Briefs, 1992 Sep. 1992 p 17-32 (For primary document see N93-15792 05-34)
Avail: CASI HC A03/MF A02

The problem of time discontinuity (or jump condition) in the coalescence/dispersion (C/D) mixing model is addressed in probability density function (pdf). A C/D mixing model continuous in time is introduced. With the continuous mixing model, the process of chemical reaction can be fully coupled with mixing. In the case of homogeneous turbulence decay, the new model predicts a pdf very close to a Gaussian distribution, with finite higher moments also close to that of a Gaussian distribution. Results from the continuous mixing model are compared with both experimental data and numerical results from conventional C/D models. The effect of Coriolis forces on compressible homogeneous turbulence is studied using direct numerical simulation (DNS). The numerical method used in this study is an eight order compact difference scheme. Contrary to the conclusions reached by previous DNS studies on incompressible isotropic turbulence, the present results show that the Coriolis force increases the dissipation rate of turbulent kinetic energy, and that anisotropy develops as the Coriolis force increases. The Taylor-Proudman theory does apply since the derivatives in the direction of the rotation axis vanishes rapidly. A closer analysis reveals that the dissipation rate of the incompressible component of the turbulent kinetic energy indeed decreases with a higher rotation rate, consistent with incompressible flow simulations (Bardina), while the dissipation rate of the compressible part increases; the net gain is positive. Inertial waves are observed in the simulation results. Author

N93-15795*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MODELING OF TURBULENCE AND TRANSITION
Tsan-Hsing Shih *In its* Center for Modeling of Turbulence and Transition (CMOTT): Research Briefs, 1992 Sep. 1992 p 33-49 (For primary document see N93-15792 05-34)
Avail: CASI HC A03/MF A02

The first objective is to evaluate current two-equation and second order closure turbulence models using available direct numerical simulations and experiments, and to identify the models which represent the state of the art in turbulence modeling. The second objective is to study the near-wall behavior of turbulence, and to develop reliable models for an engineering calculation of turbulence and transition. The third objective is to develop a two-scale model for compressible turbulence. Author

N93-15796*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TURBULENCE MODELING AND EXPERIMENTS
Aamir Shabbir *In its* Center for Modeling of Turbulence and Transition (CMOTT): Research Briefs, 1992 Sep. 1992 p 51-66 (For primary document see N93-15792 05-34)
Avail: CASI HC A03/MF A02

The best way of verifying turbulence is to do a direct comparison between the various terms and their models. The success of this approach depends upon the availability of the data for the exact correlations (both experimental and DNS). The other approach involves numerically solving the differential equations and then comparing the results with the data. The results of such a computation will depend upon the accuracy of all the modeled terms and constants. Because of this it is sometimes difficult to find the cause of a poor performance by a model. However, such a calculation is still meaningful in other ways as it shows how a complete Reynolds stress model performs. Thirteen homogeneous flows are numerically computed using the second order closure models. We concentrate only on those models which use a linear (or quasi-linear) model for the rapid term. This, therefore, includes the Launder, Reece and Rodi (LRR) model; the isotropization of production (IP) model; and the Speziale, Sarkar, and Gatski (SSG) model. Which of the three models performs better is examined along with what are their weaknesses, if any. The other work reported deal with the experimental balances of the second moment equations for a buoyant plume. Despite the tremendous amount of activity toward the second order closure modeling of turbulence, very little experimental information is available about the budgets of the second moment equations. Part of the problem stems from our inability to measure the pressure correlations. However, if everything else appearing in these equations is known from the experiment, pressure correlations can be obtained as the closing terms. This is the closest we can come to in obtaining these terms from experiment, and despite the measurement errors which might be present in such balances, the resulting information will be extremely useful for the turbulence modelers. The purpose of this part of the work was to provide such balances of the Reynolds stress and heat flux equations for the buoyant plume. Author

N93-15797*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MODELING OF TURBULENT SHEAR FLOWS
William W. Liou *In its* Center for Modeling of Turbulence and Transition (CMOTT): Research Briefs, 1992 Sep. 1992 p 67-81 (For primary document see N93-15792 05-34)
Avail: CASI HC A03/MF A02

The current progress is documented in the research and development of modeling techniques for turbulent shear flows. These include a two-scale model for compressible turbulent flows and a new energy transfer model. The former represents the status of the efforts to identify compressibility effects in turbulence. The energy transfer model refines a weakly nonlinear wave model developed earlier, which models directly the turbulent large structures. The objective of these activities is to develop second-order closures for compressible turbulent flows. Author

N93-15798*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MODELING OF NEAR WALL TURBULENCE AND MODELING OF BYPASS TRANSITION
Z. Yang *In its* Center for Modeling of Turbulence and Transition (CMOTT): Research Briefs, 1992 Sep. 1992 p 83-94 (For primary document see N93-15792 05-34)
Avail: CASI HC A03/MF A02

The objectives for this project are as follows: (1) Modeling of the near wall turbulence: We aim to develop a second order closure for the near wall turbulence. As a first step of this project, we try to develop a kappa-epsilon model for near wall turbulence. We require the resulting model to be able to handle both near wall turbulence and turbulent flows away from the wall, computationally robust, and applicable for complex flow situations, flow with separation, for example, and (2) Modeling of the bypass transition: We aim to develop a bypass transition model which contains the effect of intermittency. Thus, the model can be used for both the transitional boundary layers and the turbulent boundary layers. We require the resulting model to give a good prediction of momentum and heat transfer within the transitional boundary and a good prediction of the effect of freestream turbulence on transitional boundary layers. Author

N93-15799*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TWO EQUATION MODELLING AND THE PSEUDO COMPRESSIBILITY TECHNIQUE
C. J. Steffen, Jr. *In its* Center for Modeling of Turbulence and Transition (CMOTT): Research Briefs, 1992 Sep. 1992 p 95-100 (For primary document see N93-15792 05-34)
Avail: CASI HC A02/MF A02

The primary objective of the Center for Modelling of Turbulence and Transition (CMOTT) is to further the understanding of turbulence theory for engineering applications. One important foundation is the establishment of a data base encompassing the multitude of existing models as well as newly proposed ideas. The research effort described is a precursor to an extended survey of two equation turbulence models in the presence of a separated shear layer. Recently, several authors have examined the performance of two equation models in the context of the backward facing step flow. Conflicting results, however, demand that further attention is necessary to properly understand the behavior and limitations of this popular technique, especially the low Reynolds number formulations. The objective is to validate an incompressible Navier Stokes code for use as a numerical test-bed. In turn, this code will be used for analyzing the performance of several two equation models. Author

N93-15800*# Sverdrup Technology, Inc., Brook Park, OH.
RENORMALIZATION GROUP METHODS FOR THE REYNOLDS STRESS TRANSPORT EQUATIONS
R. Rubinstein *In* NASA. Lewis Research Center, Center for Modeling of Turbulence and Transition (CMOTT): Research Briefs, 1992 Sep. 1992 p 101-114 (For primary document see N93-15792 05-34)
Avail: CASI HC A03/MF A02

The Yakhot-Orszag renormalization group is used to analyze the pressure gradient-velocity correlation and return to isotropy terms in the Reynolds stress transport equations. The perturbation series for the relevant correlations, evaluated to lowest order in the epsilon-expansion of the Yakhot-Orszag theory, are infinite series in tensor product powers of the mean velocity gradient and its transpose. Formal lowest order Pade approximations to the sums of these series produce a rapid pressure strain model of the form proposed by Launder, Reece, and Rodi, and a return to isotropy model of the form proposed by Rotta. In both cases, the model constants are computed theoretically. The predicted Reynolds stress ratios in simple shear flows are evaluated and compared with experimental data. The possibility is discussed of deriving higher order nonlinear models by approximating the sums more accurately. The Yakhot-Orszag renormalization group provides a systematic procedure for deriving turbulence models. Typical applications have included theoretical derivation of the universal constants of isotropic turbulence theory, such as the Kolmogorov constant, and derivation of two equation models, again with theoretically computed constants and low Reynolds number forms of the equations. Recent work has applied this formalism to Reynolds stress modeling, previously in the form of a nonlinear eddy viscosity representation of the Reynolds stresses, which can be used to model the simplest normal stress effects. The present work attempts to apply the Yakhot-Orszag formalism to Reynolds stress transport modeling. Author

N93-15801*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
BYPASS TRANSITION IN COMPRESSIBLE BOUNDARY LAYERS
J. J. VanderVegt *In its* Center for Modeling of Turbulence and Transition (CMOTT): Research Briefs, 1992 Sep. 1992 p 115-125 (For primary document see N93-15792 05-34)
Avail: CASI HC A03/MF A02

Transition to turbulence in aerospace applications usually occurs in a strongly disturbed environment. For instance, the effects of free-stream turbulence, roughness and obstacles in the boundary layer strongly influence transition. Proper understanding of the mechanisms leading to transition is crucial in the design of aircraft wings and gas turbine blades, because lift, drag and heat transfer strongly depend on the state of the boundary layer, laminar or turbulent. Unfortunately, most of the transition research, both theoretical and experimental, has focused on natural transition. Many practical flows, however, defy any theoretical analysis and are extremely difficult to measure. Morkovin introduced in his review paper the concept of bypass transition as those forms of transition which bypass the known mechanisms of linear and non-linear transition theories and are currently not understood by experiments. In an effort to better understand the mechanisms leading to transition in a disturbed environment, experiments are conducted studying simpler cases, viz. the effects of free stream turbulence on transition on a flat plate. It turns out that these experiments are very difficult to conduct, because generation of free stream turbulence with sufficiently high fluctuation levels and reasonable homogeneity is non trivial. For a discussion see Morkovin. Serious problems also appear due to the fact that at high Reynolds numbers the boundary layers are very thin, especially in the nose region of the plate where the transition occurs, which makes the use of very small probes necessary. The effects of free-stream turbulence on transition are the subject of this research and are especially important in a gas turbine environment, where turbulence intensities are measured between 5 and 20 percent, Wang et al. Due to the fact that the Reynolds number for turbine blades is considerably lower than for aircraft wings, generally a larger portion of the blade will be in a laminar transitional state. The effects of large free stream turbulence in compressible boundary layers at Mach numbers are examined both in the subsonic and transonic regime using direct numerical simulations. The flow is computed over a flat plate and curved surface. while many applications operate in the transonic regime. Due the nature of their numerical scheme, a non-conservation formulation of the Navier-Stokes equations, it is a non-trivial extension to compute flow fields in the transonic regime. This project aims at better understanding the effects of large free-stream turbulence in compressible boundary layers at mach number both in the subsonic and transonic regime using direct numerical simulations. The present project aims at computing the flow over a flat plate and curved surface. This research will provide data which can be used to clarify mechanisms leading to transition in an environment with high free stream turbulence. This information is useful for the development of turbulence models, which are of great importance for CFD applications, and are currently unreliable for more complex flows, such as transitional flows. Author

N93-15802*# Sverdrup Technology, Inc., Brook Park, OH.
RUNGE-KUTTA METHODS COMBINED WITH COMPACT DIFFERENCE SCHEMES FOR THE UNSTEADY EULER EQUATIONS
Sheng-Tao Yu *In* NASA. Lewis Research Center, Center for Modeling of Turbulence and Transition (CMOTT): Research Briefs, 1992 Sep. 1992 p 127-161 (For primary document see N93-15792 05-34)
Avail: CASI HC A03/MF A02

Recent development using compact difference schemes to solve the Navier-Stokes equations show spectral-like accuracy. A study was made of the numerical characteristics of various combinations of the Runge-Kutta (RK) methods and compact difference schemes to calculate the unsteady Euler equations. The accuracy of finite difference schemes is assessed based on the evaluations of dissipative error. The objectives are reducing the numerical damping and, at the same time, preserving numerical stability. While this approach has tremendous success solving steady flows, numerical characteristics of unsteady calculations remain largely unclear. For unsteady flows, in addition to the dissipative errors, phase velocity and harmonic content of the numerical results are of concern. As a result of the discretization procedure, the simulated unsteady flow motions actually propagate in a dispersive numerical medium. Consequently, the dispersion characteristics of the numerical schemes which relate the phase velocity and wave number may greatly impact the numerical accuracy. The aim is to assess the numerical accuracy of the simulated results. To this end, the Fourier analysis is to provide the dispersive correlations of various numerical schemes. First, a detailed investigation of the existing RK methods is carried out. A generalized form of an N-step RK method is derived. With this generalized form, the criteria are derived for the three and four-step RK methods to be third and fourth-order time accurate for the non-linear equations, e.g., flow equations. These criteria are then applied to commonly used RK methods such as Jameson's 3-step and 4-step schemes and Wray's algorithm to identify the accuracy of the methods. For the spatial discretization, compact difference schemes are presented. The schemes are formulated in the operator-type to render themselves suitable for the Fourier analyses. The performance of the numerical methods is shown by numerical examples. These examples are detailed. described. The third case is a two-dimensional simulation of a Lamb vortex in an uniform flow. This calculation provides a realistic assessment of various finite difference schemes in terms of the conservation of the vortex strength and the harmonic content after travelling a substantial distance. The numerical implementation of Giles' non-refelctive equations coupled with the characteristic equations as the boundary condition is discussed in detail. Finally, the single vortex calculation is extended to simulate vortex pairing. For the distance between two vortices less than a threshold value, numerical results show crisp resolution of the vortex merging. Author

N93-15821# Chase (David M.), Inc., Boston, MA.
TURBULENT BOUNDARY-LAYER FLUCTUATIONS AT THE SOLID INTERFACE Final Report
D. M. Chase 24 Sep. 1992 7 p
(Contract N00014-88-C-0673)
(AD-A257253; CR93-01) Avail: CASI HC A02/MF A01

A bibliography and brief indication of accomplishments under the subject contract is presented along with appended reprints of published papers to date. The topics covered include the following: turbulent boundary layer, viscous boundary, fluctuating pressure, conditions, and fluctuating shear stress. GRA

N93-15851# Sandia National Labs., Albuquerque, NM.
PROPAGATION OF DISSOLUTION/PRECIPITATION WAVES IN POROUS MEDIA
C. F. Novak and S. D. Sevougian (Texas Univ., Austin.) Jul. 1992 39 p

Presented at the NATO-Advanced Study Institute Summer School on Migration and Fate of Pollutants in Soils and Subsoils, Basilicata, Italy, 24 May - 6 Jun. 1992
(Contract DE-AC04-76DP-00789)
(DE92-017348; SAND-92-0364; CONF-9205156-1) Avail: CASI HC A03/MF A01

Contaminant transpose in saturated porous media, whether advective or diffusive, occurs as propagating concentration changes. The wave interpretation of these changes provides general principles describing the ways in which concentration changes can evolve and interact during transport. If contaminants react chemically with spatially fixed phases (minerals), the transfer of the contaminants from aqueous phase to mineral phase(s) results in chemical retardation. This report focuses on the propagation of dissolution/precipitation waves and the chemical retardation produced by mineral dissolution and precipitation reactions. The assumption of local equilibrium is common for systems where transport rates can be considered slow relative to reaction rates, and results in equations for dissolution/precipitation reactions called solubility products. Because a solubility product expression is an inequality when the mineral described by it is absent, and because these expressions are independent of the amount of mineral present, mineral dissolution/precipitation waves are generally very abrupt concentration changes in the mineral and aqueous phases. These abrupt changes occur in advection- and diffusion-dominated systems. Reactions can also be described by kinetic rate expressions, resulting in a partial local equilibrium system. Unlike waves for local equilibrium dissolution/precipitation, waves controlled by dissolution kinetics can have broader widths, although these waves still propagate through the domain as a unit. Four examples are presented to focus on the wave behavior predicted for chemical transport: ID local equilibrium advective transport, ID local equilibrium diffusive transport, ID partial local equilibrium advective transport, and 2D dual porosity local equilibrium transport. DOE

N93-15857# Naval Surface Warfare Center, Dahlgren, VA.
DETAILED NEAR SURFACE FLOW ABOUT YAWED, STRANDED CABLES Report, May 1989 - Jun. 1990
S. M. Batill and J. V. Nebres Oct. 1992 146 p
(Contract N00014-83-K-0239; NR Proj. RN1-5-W-33)
(AD-A257382; CSS-CR-1210-92-1) Avail: CASI HC A07/MF A02

The results are described of the second phase of an experimental study of the flow about stranded cables or wire ropes. The purpose was to consider, in some detail, the flow field near the cable and to provide additional experimental information related to the mechanisms associated with the generation of fluid forces on the cables. The development of a steady lift or side force on a stranded cable, yawed with respect to a flow, is a unique characteristic of a cable when compared to a circular cylinder. Experiments were conducted to measure the surface pressure distributions and near wake characteristics for a variety of stranded cable geometries and a circular cylinder. Rigid cable models and cylinders were tested in a low speed wind tunnel. The models were yawed to four different yaw angles and tested within the Reynolds number range of 5,000 and 50,000. Surface pressure distributions on the yawed cables indicated that the lift force is the result of asymmetric boundary layer separation. Unsteady surface pressures on stationary cables were shown to correlate with earlier hot-wire measurements. Detailed flow visualization illustrated the complexity of the flow about the stranded cables. The influence of test support conditions were examined in order to provide a better understanding of end-effects in testing these long, slender models. GRA

N93-15882# Los Alamos National Lab., NM.
IMPACT MODELING WITH SMOOTH PARTICLE HYDRODYNAMICS
R. F. Stellingwerf and C. A. Wingate 1992 14 p Presented at the High Velocity Impact Symposium, Austin, TX, Dec. 1992
(Contract W-7405-eng-36)
(DE92-017506; LA-UR-92-1981; CONF-921221-2) Avail: CASI HC A03/MF A01

Smooth Particle Hydrodynamics (SPH) is a new computational technique uniquely suited to computation of hypervelocity impact phenomena. This paper reviews the characteristics, philosophy, and a bit of the derivation of the method. As illustrations of the technique, several test case computations and several application computations are shown. DOE

N93-15892# Woods Hole Oceanographic Inst., MA.
PARTICLE CONTACT ON FLAT PLATES IN FLOW: A MODEL FOR INITIAL LARVAL CONTACT
Elizabeth D. Garland and Lauren S. Mullineaux Jun. 1992 31 p
(Contracts N00014-89-J-1112; N00014-89-J-1431)
(AD-A257275; WHOI-92-26) Avail: CASI HC A03/MF A01

Patterns and rates of particle contact onto flat plates in steady unidirectional flows were investigated in a laboratory flume. Plates with three leading edge configurations (faired, bluff and split) were used to generate boundary-layer flows that differed in downstream patterns of plate-ward advection, turbulence and shear stress. Particle contact onto the leading edges of all plates was consistently low in 2,5, and 10 cm/s along-stream flow speeds. Contact was enhanced under separation eddies that formed over bluff and split plates, but was reduced at reattachment points. High contact rates appeared to correspond to a combination of local plate-ward advection, a thick boundary layer, and reduced shear stress. Surprisingly, particle contact rates in the 'non-varying' flow region further downstream on the plates varied only slightly between plate types and between flow speeds. Contact rates did, however, vary strongly with particle abundance in the flume. These results were used to develop a predictive model of passive larval contact rate onto settlement plates in known larval concentrations and free-stream flows. The contact model, when combined with Larval behavioral observations, provides the basis for a more objective, quantitative method of interpreting Larval settlement plates. GRA

N93-15910# Colorado Univ., Boulder.
ON A SYMMETRY OF TURBULENCE
Scott Peckham and Ed Waymire 1992 7 p
(Contract DAAL03-90-G-0016)
(AD-A256647; ARO-27772.10-GS) Avail: CASI HC A02/MF A01

This paper presents results on symmetries of the spectrum of singularities for random cascades found in the statistical theory of turbulence. It is shown that empirical dimension curves possess a natural symmetry whose presence restricts the class of allowable probability distributions of the cascade generator in a simple manner. In particular, necessary and sufficient conditions on the probability distribution of the generator are obtained for symmetry of the singularity spectrum within a large class of cascade models. GRA

N93-15923# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Nuclear Engineering and Engineering Physics.
DEVELOPMENT OF AN ELECTRICAL IMPEDANCE COMPUTED TOMOGRAPHIC TWO-PHASE FLOWS ANALYZER
O. C. Jones 31 Mar. 1992 85 p
(Contract DE-AT06-82ER-13032)
(DE92-040527; DOE/ER-13032/T2) Avail: CASI HC A05/MF A01

Description of interfacial structure and evolution, as well as the gradients which control transfer of mass, momentum, and energy at these phase boundaries is a critical challenge for the future of two-phase flow analysis. Indeed, measurement and prediction of phase boundary structure and gradients is the key element impeding development of true predictive capability for systems involving flows of liquid and vapor or gas mixtures. The current status is summarized of research being undertaken for the development of an electrical impedance method which can then be used for computed tomographic reconstruction of the flow field. The concept is relatively straight forward. A volume of a liquid-vapor flow is excited electrically through means of boundary electrodes. The response is measured and the internal distribution of electrical properties is determined which best matches the measured response. This is termed an 'inverse problem' since it is directly inverse to the 'forward problem' where the field properties and boundary conditions are known and the electrical field is computed. Since both electrical resistivity and permittivity of water and vapor are significantly different in each fluid, development of this method having sufficient rapidity will allow interfacial structure and evolution to be determined for two-phase flows. Methods for solution to this nonlinear problem are iterative in nature. A property distribution is assumed, response to the applied excitation is calculated and compared with the measured response, and calculations in the original distribution are undertaken which push the calculations in the direction of the measurements. We attempt to minimize the mean-square error between the computations and the measurements

on the boundary by suitable adjustment of the internal distribution of resistivity and permittivity. DOE

N93-15956# California Univ., Davis.
PARTICLE DISPERSION IN A TURBULENT SHEAR FLOW Final Report, 15 May 1989 - 15 May 1992
Ian M. Kennedy and Wolfgang Kollmann 15 Jul. 1992 44 p
(Grant AF-AFOSR-0392-89)
(AD-A255681; AFOSR-92-0873TR) Avail: CASI HC A03/MF A01

A joint experimental and computational study of droplet dispersion in a round turbulent jet were performed. Truly Lagrangian measurements of droplet dispersion were obtained with a laser scattering method. A low noise, high frequency response photomultiplier tube was used to track the location of particles as they traversed a sheet of laser light. Measurements of a single droplet at many closely spaced axial locations were obtained and were analyzed in terms of droplet times of flight to give Lagrangian statistics. The computational phase of the project consisted of stochastic simulations of droplet dynamics using the velocity statistics provided by a second order closure model for the jet flow, vortex dynamics for the initial region of the jet at infinite Reynolds number, and finally a large eddy simulation method for the jet flow at finite Reynolds numbers. The droplet trajectories were computed to second order accuracy in each ease. The large eddy simulation of a jet at a Reynolds number of 15,000 using the discretization error as filters showed very good results up to forty diameters downstream. GRA

N93-15985# Naval Postgraduate School, Monterey, CA.
A STUDY OF FILM COOLING DOWNSTREAM OF ONE AND TWO ROWS OF HOLES ORIENTED IN SPANWISE/NORMAL PLANES M.S. Thesis
Anthony E. Ramsey Sep. 1992 269 p
(AD-A257325) Avail: CASI HC A12/MF A03

Experimental results are presented which describe the development and structure of flow downstream of a single row and two staggered rows of film cooling holes with compound angle orientations. With the configuration studied, holes are inclined at 90 degs with respect to the test surface when projected into the streamwise/normal plane, and 30 degs with respect to the test surface when projected into the spanwise/normal plane. Within each row, holes are spaced 6.0 hole diameter apart in the spanwise direction which gives 3.O d spacing between adjacent holes for the staggered row arrangement. Also presented are plots showing the streamwise development of injectant distributions and streamwise development of mean velocity distributions. Spanwise averaged values of the adiabatic film cooling effectiveness depend mostly on four parameters: hole angle orientation, spanwise hole spacing, number of rows of film cooling holes (one or two), and blowing ratio. Spanwise averaged values of the adiabatic film cooling effectiveness are generally greatest at low x/d and decrease with increasing x/d values for any given blowing ratio. Spanwise averaged effectiveness values decrease with blowing ratio for x/d less than 40 except for data for m = 2.5. This trend generally reverses itself at higher x/d values. Spanwise averaged isoenergetic Stanton number ratios range between 1.0 and 1.5 and show little variation as x/d increases for each value of blowing ratio, however for each x/d, values increase with increasing blowing ratio. GRA

N93-16124# Naval Postgraduate School, Monterey, CA.
EXPERIMENTAL DEVELOPMENT OF TUBESIDE HEAT TRANSFER CORRELATIONS FOR LAMINAR FLOW WITH AND WITHOUT INSERTS M.S. Thesis
Joseph D. Guido Sep. 1992 176 p
(AD-A257099) Avail: CASI HC A09/MF A02

An experimental study of laminar flow heat transfer of an ethylene glycol/water mixture in an electrically heated horizontal tube using wire mesh (HEATEX) and twisted tape inserts was investigated. Twelve thermocouples, inserted in the tube wall at four longitudinal locations, enabled a mean inside experimental heat-transfer coefficient to be accurately measured. A constant wall heat flux boundary condition was placed on the wall by wrapping six 200 W flexible heater tapes tightly around the tube. The ethylene glycol/water mixture provided a coolant Reynolds number between 200-5000 and a Prandtl number between 30-140. Two smooth inside diameters and a roped tube profile were tested with and without the inserts. Heat-transfer correlations for tubes without inserts were developed and compared with theory for both thermally and hydrodynamically developing flow. Correlations were also developed for the two types of inserts. Nusselt numbers for fully developed flow were found to be a function of Reynolds and Prandtl numbers for the wire mesh insert and a function of tape twist ratio, Reynolds and Prandtl numbers for the twisted tape insert. Heat transfer enhancements of over 7 for the wire mesh insert and over 4 for the twisted tape insert at high Reynolds numbers were obtained over the empty tube. GRA

N93-16126# Naval Postgraduate School, Monterey, CA.
NATURAL CONVECTION FROM A HORIZONTAL HEATER IN RESPONSE TO STEADY AND PULSATILE INPUT POWERS M.S. Thesis
Christopher N. Hickey Jun. 1992 83 p
(AD-A257101) Avail: CASI HC A05/MF A01

Natural convection heat transfer from a flush mounted heater on a larger horizontal substrate in water has been investigated for both steady and periodic input powers. For steady power conditions, the heat flux was varied from 222 to 6880 W/sq m. Heater surface temperatures were measured at several locations in order to develop a non-dimensional heat transfer correlation. Three types of periodic input powers were tested: a triangular wave, an approximate square wave, and a sinusoidal wave. Mean, amplitude, and frequency were varied for each wave. Temperature measurements at selected heater locations were compared with steady state conditions to determine heat transfer enhancement. GRA

N93-16159# Argonne National Lab., IL.
PRESENT STATE-OF-THE-ART OF TWO-PHASE FLOW MODEL CALCULATIONS
R. W. Lyczkowski, Jianmin Ding, and J. X. Bouillard Jul. 1992 11 p
Presented at the International Symposium on Energy, Environment and Information Management, Argonne, IL, 15-18 Sep. 1992
(Contract W-31-109-eng-38)
(DE92-041124; ANL/CP-76147; CONF-9209160-10) Avail: CASI HC A03/MF A01

Argonne National Laboratory (ANL) has developed two- and three-dimensional computer programs to predict hydrodynamics in complex fluid/solids systems including atmospheric and pressurized bubbling and circulating fluidized-bed combustors and gasifiers, concentrated suspension (slurry) piping systems and advanced particle-bed reactors for space-based applications, for example. The computer programs are based upon phenomenological mechanistic models and can predict frequency of bubble formation, bubble size and growth, bubble frequency and rise-velocity, solids volume fraction, gas and solids velocities and low dimension chaotic attracters. The results of these hydrodynamic calculations are used as inputs to mechanistic models to predict heat transfer and erosion and have been used to produce simplified models and guidelines to assist in design and scaling. An extensive coordinated effort involving industry, government, and university laboratory data has served to validate the various models. Babcock & Wilcox (B&W), in close collaboration with ANL, has developed the three dimensional FORCE2 computer program which is both transient as well as steady state. DOE

N93-16375*# Scientific Research Associates, Inc., Glastonbury, CT.
VERIFICATION OF INTERNAL FLOW ANALYSES IN COMPLEX 3-D GEOMETRIES Final Report, 24 Apr. 1989 - 31 Aug. 1992
S. K. Choi and R. C. Buggeln Nov. 1992 53 p Original contains color illustrations
(Contract NAS8-37363)
(NASA-CR-191250; NAS 1.26:191250; R92-900076-F) Avail: CASI HC A04/MF A01; 4 functional color pages

Analysis of internal flow in advanced rocket propulsion systems is complicated by hardware geometry, high Reynolds numbers, rotation, high frequency phenomena, and near incompressibility. Typical of such a problem is the Space Shuttle Main Engine (SSME) hot gas manifold (HGM). Previous analyses of flow in the SSME HGM have been compared to air flow data and found to be inaccurate with respect to system losses, outer wall static pressures, and transfer duct environments. Such discrepancies could arise from flow measurement methodology, low order algorithms, turbulence modeling, and/or inadequate grid resolution. The objective of this work is to compare internal flow computational analyses to LDV flow measurements for the MSFC HGM pilot model configuration using two grids of different node density in the near wall region. Grids were generated with the EAGLE

grid generator and calculations were made with the SRA MINT code. The calculated results were compared with HGM experimental data obtained in the MSFC water flow facility. Author

N93-16378# Wisconsin Univ., Milwaukee. Dept. of Mechanical Engineering.
INTERFACIAL AREA AND INTERFACIAL TRANSFER IN TWO-PHASE FLOW SYSTEMS
G. Kojasoy Aug. 1992 5 p
(Contract DE-FG02-87ER-13764)
(DE93-000647; DOE/ER-13764/T3) Avail: CASI HC A01/MF A01

Experiments were performed on horizontal air-water bubbly two-phase flow, axial flow, stratified wavy flow, and annular flow. Theoretical studies were also undertaken on interfacial parameters for a horizontal two-phase flow. DOE

N93-16379*# Vigyan Research Associates, Inc., Hampton, VA.
MODELING AND CONTROL STUDY OF THE NASA 0.3-METER TRANSONIC CRYOGENIC TUNNEL FOR USE WITH SULFUR HEXAFLUORIDE MEDIUM
S. Balakrishna and W. Allen Kilgore Dec. 1992 62 p
(Contract NAS1-18585; RTOP 505-59-86-02)
(NASA-CR-189737; NAS 1.26:189737) Avail: CASI HC A04/MF A01

The NASA Langley 0.3-m Transonic Cryogenic Tunnel is to be modified to operate with sulfur hexafluoride gas while retaining its present capability to operate with nitrogen. The modified tunnel will provide high Reynolds number flow on aerodynamic models with two different test gases. The document details a study of the SF6 tunnel performance boundaries, thermodynamic modeling of the tunnel process, nonlinear dynamical simulation of math model to yield tunnel responses, the closed loop control requirements, control laws, and mechanization of the control laws on the microprocessor based controller. Author

N93-16401# ManTech Environmental Technology, Inc., Dayton, OH.
A HIGH PRESSURE AEROSOL GENERATOR FOR VISCOUS FLUIDS Final Report, Jan. - Sep. 1990
E. C. Kimmel, H. F. Leahy, and R. L. Carpenter Sep. 1991 36 p
(Contract F33615-90-C-0532)
(AD-A256269; AL-TR-1991-0148) Avail: CASI HC A03/MF A01

A generator was developed for examination of the potential adverse health effects of respirable size aerosols of hydraulic fluids under high pressures (1000 to 1500 psi) released through micro-orifice pin-hole (2.03 x 10 exp 2 cm diameter) breaches in the hydraulic system. Tests with the oil-in-water emulsion hydraulic fluid designated as HS 5047F, used in Naval systems, demonstrated that at various fluid pressures respirable size aerosols (ranging from 2.8 to 4.2 micron mass median aerodynamic diameter) can be delivered at concentrations up to 163 mg/m exp 3 and higher, given the appropriate conditions. A series of mathematical expressions was developed to predict aerosol droplet size as a function of nozzle orifice diameter and physical characteristics of the test fluid such as viscosity, density, and surface tension. GRA

N93-16411# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
COMPARISON OF SOLUTION OF VARIOUS EULER SOLVERS AND ONE NAVIER-STOKES SOLVER FOR THE FLOW ABOUT A SHARP-EDGED CROPPED DELTA WING
B. R. Williams (Royal Aerospace Establishment, Farnborough, England), W. Kordulla (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany), M. Borsi (Aeritalia S.p.A., Turin, Italy), and H. W. M. Hoeijmakers 28 Aug. 1990 17 p Presented at AGARD Dynamics Symposium on Vortex Flow Aerodynamics, Scheveningen, Netherlands, 1-4 Oct. 1990 Sponsored by Netherlands Agency for Aerospace Programs
(NLR-TP-90340-U; ETN-93-92863) Avail: CASI HC A03/MF A01

The flow about a sharp edged cropped 65 deg delta wing was calculated. Numerical solutions obtained with different Euler methods are compared with each other, with the numerical solution of a Reynolds averaged Navier-Stokes method and with experimental data. At the selected free stream Mach number of 0.85 and angle of attack of 10 deg the flow features a leading edge vortex, is transonic but contains weak shocks only. The results of the Euler methods were obtained on one and the same C-H type of grid with close to 300,000 cells. The investigation indicates that for the test case considered there are significant differences between results from different Euler methods. The correlation of the Euler solutions with experimental data shows much larger differences due to the failure to represent secondary separation in the Euler methods. The results of the Reynolds averaged Navier-Stokes method demonstrate an improved correlation of theory and experiment. ESA

N93-16425# Toronto Univ. (Ontario). Thermodynamics and Kinetics Lab.
STABILITY OF MULTIPHASED ROTATING FLUID SYSTEMS SUBJECTED TO VARIABLE GRAVITATIONAL FORCES, PHASE 1 Final Report
Charles A. Ward and D. Yee Apr. 1989 52 p
(Contract DSS-31016-0-6058/04-SW)
(CTN-93-60610) Avail: CASI HC A04/MF A01

Both the stability and shape of the phase boundary formed when a bubble is immersed in a liquid are considered for the case of a fluid rotating about an axis with which the volume is symmetric and free of gravitational effects. A thermodynamic formulation of the problem leads to a system of equations for predicting the shape of the phase boundary in terms of the temperature, total volume, total mass, and rotation rate, all measurable and controllable parameters. A new method has been developed for predicting the value of the radius of the phase boundary at the apex of the vapor phase. Once the value of this radius is predicted, the shape of the rest of the phase boundary can be predicted by a simple numerical integration procedure. When the possible equilibrium states of the system are examined, it is found that there are two equilibrium values of the apex radius. If the configuration of the phase boundary corresponds to the smaller of these two equilibrium values, then the vapor phase is unstable. Displacement towards larger values of the apex radius results in the vapor phase growing to the larger equilibrium size, where it is effectively stable if the rotation rate is not too high. The phase boundary shape is strongly affected by the rotation rate; at higher rates, the bubble may break up into more than one bubble. Author (CISTI)

N93-16439*# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.
VIBRATION DISSOCIATION COUPLING IN NONEQUILIBRIUM FLOWS Final Report
Graham V. Candler 18 Dec. 1992 11 p Submitted for publication
(Contract NCA2-519)
(NASA-CR-191775; NAS 1.26:191775) Avail: CASI HC A03/MF A01

The final report on research between North Carolina State University and the NASA Ames Research Center is presented. The research was aimed at using the Schwartz, Slawsky, Herzfeld (SSH) theory to simulate the vibrational relaxation of nitrogen molecules undergoing dissociation or recombination over a wide range of conditions. The results of these simulations were then treated as exact, and they were used to develop a model for the coupled vibration-dissociation process. This new model is simple enough to be used in computational fluid dynamics codes, but still captures the physics of the complex process. The model is used to simulate the flow over typical geometries to test it and to determine how much impact it has on the flow field. The key elements of this research are summarized. Author

N93-16478# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 6: Calcul Scientifique, Modelisation et Logiciels Numeriques.
COMPUTATIONAL FLUID DYNAMICS WITH IRREGULAR GRIDS ON THE CONNECTION MACHINE
Charbel Farhat (Colorado Univ., Boulder.), Loula Fezoui, and Stephane Lanteri Apr. 1991 34 p
(INRIA-RR-1411; ETN-93-92636) Avail: CASI HC A03/MF A01

Effort in solving two dimensional Euler equations on the Connection Machine CM-2 model using a mixed finite volume/finite element method on fully unstructured grids is reported. Because the mesh irregularities inhibit the use of the North-East-West-South (NEWS) fast communication mechanism, focus is laid on the development and implementation of a communication efficient strategy for mapping thousands of processors arranged in a hypercube topology onto an arbitrary mesh. The main objective is to minimize the interprocessor communication costs that are induced by the Router while still maintaining a high level of parallelism and load

balancing in the computations. Performance results for internal and external flow problems indicate that a 16 K CM-2 with single precision floating point arithmetic is at least as fast as one processor Cray-2 and in some cases twice as fast for solving such problems, and this for a virtual processor ratio as small as one. ESA

N93-16513 Colorado Univ., Boulder.
DIRECT NUMERICAL SIMULATION OF TURBULENT FLOW IN A SQUARE DUCT Ph.D. Thesis
Asmund Huser 1992 256 p
Avail: Univ. Microfilms Order No. DA9232693

A study for generating an accurate description of fully developed, low Reynolds number, anisotropic turbulent flow in a square duct is presented. The present numerical scheme employs a time-splitting method to integrate the three dimensional, incompressible Navier-Stokes equations using spectral/finite difference discretization on a staggered mesh. The new numerical code resulting from this work is tailored to the solution of the square duct flow and optimized for operation on the Cray Y-MP supercomputer. Time averaged results from the fully developed turbulent field are compared with available experimental and numerical results and show good qualitative agreement. The existence of two inhomogeneous directions in the transverse plane results in an anisotropic primary shear stress distribution; this is shown to result in convection of mean velocity. By investigating the equations for the mean secondary velocity and streamwise vorticity, it is demonstrated that the mechanisms responsible for the anisotropic secondary Reynolds stresses result in the production of secondary flow. Higher order correlations are presented with emphasis on the behavior of the Reynolds stress and the dissipation rate budgets along the two intersecting walls. These results are used to investigate the dynamics of the Reynolds stress transport equations where it is demonstrated how the anisotropic pressure velocity interactions redistributes energy and shear stresses between the turbulent stresses, promoting the distorted isotachs and the mean secondary flow. The dissipation processes are studied by identifying small-scale topological patterns and show little influence of the corner outside the viscous sublayer. The transport equations for the turbulent dissipation rate and the turbulent enstrophy are evaluated and it is shown that these budgets have the same dynamics near the wall except for two production terms acting in the viscous sub-layer. The effect of the corner inside the viscous sub-layer is manifested by a vanishing production of dissipation close to the corner. The vortex dynamics responsible for the generation of the secondary flow is studied by an extended quadrant analysis and by identifying instantaneous turbulence structures. The mean secondary flow pattern, the distorted isotachs and the anisotropic Reynolds stress distribution can be explained by the preferred location of an ejection structure near the corner and the interaction between bursts from the two intersecting walls. Dissert. Abstr.

N93-16517# Cape Cod Research, East Falmouth, MA.
HIGH TEMPERATURE SMART SENSORS AND ACTUATORS Final Report
Oscar J. Almeida, Brian G. Dixon, Jill H. Hardin, John P. Sanford, and Myles Walsh Aug. 1992 42 p
(Contract DAAL03-92-C-0007)
(AD-A256985; ARO-29452.1-MS-SBI) Avail: CASI HC A03/MF A01

A new class of electroviscous fluids was synthesized and found experimentally to display a 2000 percent increase in viscosity when placed under electric field strengths on the order of 2 kv/mm. Measured viscosity increases are directly proportional to applied field strength. The effect is very fast and appears to be reversible. GRA

N93-16543# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Hauptabt. Windkanaele.
ON FLUTTER BEHAVIOR OF A 2-D COMPRESSOR CASCADE IN INCOMPRESSIBLE FLOW Ph.D. Thesis - Technische Hochschule [ZUM FLATTERVERHALTEN EINES 2-D VERDICHTERGITTERS IN INKOMPRESSIBLER STROEMUNG]
Werner Sachs Sep. 1991 128 p In GERMAN
(DLR-FB-91-26; ETN-93-92397) Avail: CASI HC A07/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Investigations on unsteady aerodynamics and flutter behavior of a compressor cascade in a newly developed wind tunnel for incompressible flow are described. Several new details of the design of the wind tunnel, the measurement section, the data processing system, and the computer supported measurement control system, are presented. The results of the extensive systematic measurements of unsteady pressure distributions on the constrained excited cascade are described and discussed. Investigations of flutter stability and additional flutter cases are presented. ESA

N93-16544# Toronto Univ. (Ontario). Thermodynamics and Kinetics Lab.
STABILITY OF MULTIPHASED ROTATING FLUID SYSTEMS SUBJECTED TO VARIABLE GRAVITATIONAL FORCES, PHASE 3 Final Report
Charles A. Ward, D. Yee, J. A. Wade, and P. A. Dickstein May 1991 156 p
(Contract DSS-310161-0-6058/01-SW)
(CTN-93-60611) Avail: CASI HC A08/MF A02

A thermodynamic method was developed to predict the shape of the phase boundary in isothermal, constant volume, constant mass, rotating, two phase fluid systems. The shape is predicted in terms of experimentally controllable variables for the system. A nondimensional parameter is then defined, and provided that it is small compared to unity, gravitational effects may be neglected. A set of experiments was performed under conditions where this restriction is satisfied. It is found that the length of the vapor phase may be predicted with the proposed method. An experimental study was also conducted in KC-135 flights to examine the stability of the fluid-fluid interphase in a rotating fluid system in which a gravitational field is applied perpendicular to the axis of rotation. The parameters which govern stability were determined. A method was also developed to predict the equilibrium configurations of a droplet rotating in an isothermal, closed, constant size volume. If the complete conditions for thermodynamic equilibrium are imposed, the possible shapes of the droplet may be predicted in terms of experimentally controlled variables. Finally, theory was applied to develop a method for determining interfacial tensions from the measurement of both the shape of a rotating drop and the shape of a sessile drop.
Author (CISTI)

N93-16557*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
INVESTIGATION OF UPWIND, MULTIGRID, MULTIBLOCK NUMERICAL SCHEMES FOR THREE DIMENSIONAL FLOWS. VOLUME 1: RUNGE-KUTTA METHODS FOR A THIN LAYER NAVIER-STOKES SOLVER Final Report, period ending 15 Sep. 1992
Frank E. Cannizzaro and Robert L. Ash Dec. 1992 185 p
(Grant NAG1-633)
(NASA-CR-191648; NAS 1.26:191648) Avail: CASI HC A09/MF A02

A state-of-the-art computer code has been developed that incorporates a modified Runge-Kutta time integration scheme, upwind numerical techniques, multigrid acceleration, and multi-block capabilities (RUMM). A three-dimensional thin-layer formulation of the Navier-Stokes equations is employed. For turbulent flow cases, the Baldwin-Lomax algebraic turbulence model is used. Two different upwind techniques are available: van Leer's flux-vector splitting and Roe's flux-difference splitting. Full approximation multi-grid plus implicit residual and corrector smoothing were implemented to enhance the rate of convergence. Multi-block capabilities were developed to provide geometric flexibility. This feature allows the developed computer code to accommodate any grid topology or grid configuration with multiple topologies. The results shown in this dissertation were chosen to validate the computer code and display its geometric flexibility, which is provided by the multi-block structure. Author

N93-16558*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
VOLUME 2: EXPLICIT, MULTISTAGE UPWIND SCHEMES FOR EULER AND NAVIER-STOKES EQUATIONS Final Report, period ending 15 Sep. 1992
Alaa Elmiligui and Robert L. Ash Dec. 1992 214 p
(Grant NAG1-633)
(NASA-CR-191647; NAS 1.26:191647) Avail: CASI HC A10/MF A03

The objective of this study was to develop a high-resolution-explicit-multi-block numerical algorithm, suitable for efficient computation of the three-dimensional, time-dependent Euler and Navier-Stokes equations. The resulting algorithm has employed a finite

volume approach, using monotonic upstream schemes for conservation laws (MUSCL)-type differencing to obtain state variables at cell interface. Variable interpolations were written in the k-scheme formulation. Inviscid fluxes were calculated via Roe's flux-difference splitting, and van Leer's flux-vector splitting techniques, which are considered state of the art. The viscous terms were discretized using a second-order, central-difference operator. Two classes of explicit time integration has been investigated for solving the compressible inviscid/viscous flow problems--two-state predictor-corrector schemes, and multistage time-stepping schemes. The coefficients of the multistage time-stepping schemes have been modified successfully to achieve better performance with upwind differencing. A technique was developed to optimize the coefficients for good high-frequency damping at relatively high CFL numbers. Local time-stepping, implicit residual smoothing, and multigrid procedure were added to the explicit time stepping scheme to accelerate convergence to steady-state. The developed algorithm was implemented successfully in a multi-block code, which provides complete topological and geometric flexibility. The only requirement is C degree continuity of the grid across the block interface. The algorithm has been validated on a diverse set of three-dimensional test cases of increasing complexity. The cases studied were: (1) supersonic corner flow; (2) supersonic plume flow; (3) laminar and turbulent flow over a flat plate; (4) transonic flow over an ONERA M6 wing; and (5) unsteady flow of a compressible jet impinging on a ground plane (with and without cross flow). The emphasis of the test cases was validation of code, and assessment of performance, as well as demonstration of flexibility. Author

N93-16575# Rome Univ. (Italy). Dipartimento di Fisica.
PASSIVE SCALAR FLUCTUATIONS IN INTERMITTENT TURBULENCE
A. Crisanti (Institute for Scientific Interchange, Turin, Italy), M. Falcioni (Lausanne Univ., Switzerland), G. Paladin, and A. Vulpiani (Aquila Univ., Italy) 30 Jan. 1991 8 p Submitted for publication
(Preprint-779; ETN-93-92892) Avail: CASI HC A02/MF A01

Work to discuss how the spatial intermittency of energy dissipation in three dimensional flow developed turbulence affects the small scale statistics of passive scalars is presented. The passive scalar behavior is related to the diffusion properties of particle pairs in turbulent fluids. The intermittency correction to the -5/3 Obukhov-Corrsin law for the power spectrum of a passive scalar is found. The molecular diffusion and viscosity play a negligible role. This correction is positive at difference with the negative correction to the -5/3 Kolmogorov law for the energy spectrum. It is shown that the structure functions of passive scalars have scaling exponents linear in the moment order, even in the framework of multifractal models. ESA

N93-16578# Manchester Univ. (England). Aeronautical Engineering Group.
THERMOCLINE WAVES NEAR TO A FREE SURFACE Thesis
F. A. Paonessa and T. N. Stevenson Apr. 1992 183 p Sponsored in part by RAE
(Aero-Rept-9214; ETN-92-92781) Avail: CASI HC A09/MF A02

Internal wave wakes and their effects are introduced. The conditions under which they can occur are discussed. Comparison is made with the work of Ekman. A 5 m towing tank was designed along with various ancillary systems to enable the experimental investigation into the way in which surface and subsurface bodies can generate internal waves when a stratification is present. The dimensional analysis relevant to the experimental work and to the design of the towing tank is discussed, and a theoretical analysis of internal wave propagation in stratified flows and particularly internal wave propagation in thermoclines, is given. Particle tracking experiments with submerged bodies moving in a thermocline were conducted and the experimental technique is described and some outputs are shown. Results from schlieren and conductivity probe investigations of submerged bodies moving in a thermocline are compared with the thermocline theory and these are shown to give good agreement in most cases. This work is then extended to cover surface vessels moving through density stratified fluid. Small amplitude ray theory and the solution of Krauss' (1966) dispersion relation are compared. Good agreement is shown for comparisons of wavelengths predicted by the two theories for internal waves on a tanh density profile thermocline. ESA

N93-16612*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PHYSICAL VAPOR TRANSPORT OF MERCUROUS CHLORIDE UNDER A NONLINEAR THERMAL PROFILE
Christophe Mennetrier, Walter M. B. Duval, and Narsingh B. Singh (Westinghouse Science and Technology Center, Pittsburgh, PA.) Nov. 1992 18 p
(RTOP 674-21-05)
(NASA-TM-105920; E-7413; NAS 1.15:105920) Avail: CASI HC A03/MF A01

Our study investigates numerically the flow field characteristics during the growth of mercurous chloride (Hg2Cl2) crystals in a rectangular ampoule under terrestrial and microgravity conditions for a nonlinear thermal gradient. With a residual gas lighter than the nutrient, the solutal Grashof number is dominant. We observe that in tilted configurations, when solutal convection is dominant, the maximum transport rate occurs at approximately 40 percent. For the vertical configurations, we were able to obtain solutions only for the cases either below the critical Rayleigh numbers or the stabilized configurations. The total mass flux decreases exponentially with an increase of pressure of residual gas, but it increases following a power law with the temperature difference driving the transport. The nonlinear thermal gradient appears to destabilize the flow field when thermal convection is dominant for both vertical top-heated and bottom-heated configurations. However, when the solutal Grashof number is dominant, the density gradient resulting from the solutal gradient appears to stabilize the flow for the bottom-heated configuration. The flow field for the top-heated configuration is destabilized for high Grashof numbers. The microgravity environment provides a means for lowering convection. For gravity levels of 10(exp -3) g(0) or less, the Stefan wind drives the flow, and no recirculating cell is predicted. Author

N93-16628# Wichita State Univ., KS. Dept. of Mechanical Engineering.
STREAMWISE COMPUTATION OF A CIRCULAR-TO-RECTANGULAR TRANSITION DUCT POTENTIAL FLOW FIELD
M. S. Greywall and A. Youssef Oct. 1992 22 p
(NIAR-92-17) Avail: CASI HC A03/MF A01

Computations of potential flow through a circular-to-rectangular transition duct are presented. Computations are based on a new approach that uses two stream functions to compute three-dimensional flows. This approach leads to a simple and fast algorithm to compute three-dimensional flows through complex geometries. The results of the computations are compared with the available experimental data. Author

N93-16703*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CRITICAL ASSESSMENT OF REYNOLDS STRESS TURBULENCE MODELS USING HOMOGENEOUS FLOWS
Aamir Shabbir and Tsan-Hsing Shih Dec. 1992 31 p Presented at the 31st Aerospace Sciences Meeting, Reno, NV, 11-14 Jan. 1993; sponsored by AIAA
(RTOP 505-62-21)
(NASA-TM-105954; ICOMP-92-24; E-7474; NAS 1.15:105954; CMOTT-92-12) Avail: CASI HC A03/MF A01

In modeling the rapid part of the pressure correlation term in the Reynolds stress transport equations, extensive use has been made of its exact properties which were first suggested by Rotta. These, for example, have been employed in obtaining the widely used Launder, Reece and Rodi (LRR) model. Some recent proposals have dropped one of these properties to obtain new models. We demonstrate, by computing some simple homogeneous flows, that doing so does not lead to any significant improvements over the LRR model and it is not the right direction in improving the performance of existing models. The reason for this, in our opinion, is that violation of one of the exact properties can not bring in any new physics into the model. We compute thirteen homogeneous flows using LRR (with a recalibrated rapid term constant), IP and SSG models. The flows computed include the flow through axisymmetric contraction; axisymmetric expansion; distortion by plane strain; and homogeneous shear flows with and without rotation. Results show that for most general representation for a model linear in the anisotropic tensor, performs either better or as good as the other two models of the same level. Author

N93-16733 Tel-Aviv Univ. (Israel). School of Physics and Astronomy.
STABILITY OF ELLIPTICAL VORTICES M.S. Thesis

Nathan Stein Jul. 1990 80 p
(ITN-93-85181) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

An analysis of the stability of an elliptical vortex is presented. The standard linear inviscid stability theory is used, and a solution is found for the eigenmodes of the Euler equation linearized about the flow field of an elliptical vortex. A set of coordinates was discovered which facilitated the analysis through obtaining a second order discrete recursion relation for the coefficient of the pressure modes. This equation is shown to be equivalent to a Floquet type second order differential equation. The growth rates of the unstable modes of the equation were evaluated numerically and the results agreed with those which Bayly obtained by assuming a rotating plane wave solution to the stability equations. Analytical results were obtained for the cases of very small and very large aspect ratios; the latter gave a wide instability zone and growth rates depending logarithmically on the aspect ratio, E. Analysis of the general initial condition problem showed that the set of eigenmodes of the stability problem is complete, in the sense that any initial incompressible perturbation of the basic flow is expressible as a linear combination of such eigenmodes. Thus, the time development of any perturbation is a combinbation of pure exponentials in time. The possibility of a construction of a wave packet, as a linear combination of all possible eigenmodes having the same growth rate, mostly localized in space, has been checked. A combination has been constructed through the projections of a delta function in space on the eigenmodes. The resulting wave packet is localized on the surface of a double 'cone', having an elliptical cross section, and apex located at a point aroung which a localized perturbation is sought. The spatial decay along the cone's surface scales as the absolute value of (x - x sub 0) exp -1/2. The wave packet does not disperse in time; it moves along the original elliptical streamlines. It is possible tha the type of localized modes obtained in this work is related to the phenomenon of 'spots' of strongly turbulent activity, which are reported in experiments. Author (ISA)

N93-16809# National Aerospace Lab., Tokyo (Japan).
PROCEEDINGS OF THE 7TH AND 8TH NAL WORKSHOPS ON INVESTIGATION AND CONTROL OF BOUNDARY-LAYER TRANSITIION [KYOUKAISOU SENI NO KAIMEI TO SEIGYO KENKYUUKAI KOUEN RONBUNSHUU (DAI 7 KAI TO DAI 8 KAI)]
Sep. 1991 92 p In ENGLISH and JAPANESE Workshops held in Tokyo, Japan, 26-28 Sep. 1990 and 18-19 Mar. 1991
(NAL-SP-15; JTN-92-80389) Avail: CASI HC A05/MF A01

The following topics were discussed: research activities on flow stability and instability of boundary layers including boundary layer separation, three dimensional boundary layer transition including transition on sweptback wing and on a swept cylinder, vortex and turbulent structure formation, numerical simulation of thermal convection, and boundary layer control on transition and turbulent flow. For individual titles, see N93-16810 through N93-16829.

N93-16810# Osaka Prefecture Univ., Sakai (Japan). Coll. of Engineering.
INSTABILITY OF SPATIALLY PERIODIC FLOWS [SHUUKIRYUU NO ANTEISEI]
Kenefusa Gotou *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 1-4 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Theoretical approaches to the instability of parallel or cellular periodic flows are surveyed. Author (NASDA)

N93-16811# Toyohashi Univ. of Technology, Aichi (Japan). Dept. of Energy Engineering.
COHERENT VORTEX STRUCTURE IN A TWO-DIMENSIONAL EXCITED JET [REIKI SARETA NIJIGEN FUNRYUUBA NO CHITSUJO UZU KOUZOU]
Hideharu Makita, Takeshi Matsumoto, and Kouji Sasa *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 5-9 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Experimental investigation was made for the structure of coherent vortices in a two dimensional excited jet with a parabolic velocity distribution. Two characteristic modes of velocity fluctuation in the two dimensional jet, i.e., the symmetrical and antisymmetrical mode, were acoustically excited to improve the reproducibility in appearance of the vortex arrangement in each exciting mode. The employment of conditional sampling and phase averaging for the hot-wire outputs made it possible to catch the coherent vortex arrangements was clearly observed in vorticity contour maps. In each exciting mode, the convection velocity determined by the vorticity contour map was kept almost constant during the coherent vortex traveled downstream through the linear interaction, nonlinear interaction and randomizing regions. Author (NASDA)

N93-16812# Institute of Flow Research, Tokyo (Japan).
TURBULENCE RESEARCH: WHERE SHOULD WE GO? [RANRYUU KENKYUU NO YUKUE?]
Hiroshi Satou *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 11-14 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Study of turbulent flows has two faces. One is as a branch of physics and the other is as a basis of technology concerning flows of fluid. As physics many concepts in turbulence, for instance, vortex and ordered motions have to be clarified. Experimentalists should work for new discoveries. Computations must also aim at new findings. The technical applications should include turbulence management, control of separation and phase change. Author (NASDA)

N93-16813# Tohoku Univ., Sendai (Japan). Faculty of Engineering.
EFFECTS OF SOUND ON THE ARTIFICIALLY GENERATED LONGITUDINAL VORTEX PAIR IN BOUNDARY LAYER [KYOUKAISOU CHUU NI JINKOUTEKI NI TSUKURARETA TATEUZU NI TAISURU ONPA NO EIKYOU]
Yasuaki Kohama, T. J. Wang, and Yuu Fukunishi *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 15-18 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Characteristics of secondary instability which originates from a longitudinal vortex pair due to the unstable inflectional velocity profile between their axes in a boundary layer is investigated experimentally. The longitudinal vortex pair is generated artificially by blowing air from a longitudinal slit in a flatplate. Behavior of secondary instability fluctuation under the influence of sound is also examined. A nonlinear interaction observed between generated sound frequencies and its corresponding peak frequencies is shown on spectrum analysis. The flow field under the influence of secondary instability is influenced by the sound. Author (NASDA)

N93-16814# Osaka Prefecture Univ., Sakai (Japan). Coll. of Engineering.
CONSIDERATION ON BOUNDARY-LAYER RECEPTIVITY [KYOUKAISOU NO JUYOUSEI NI KANSURU KOUSATSU]
Michio Nishioka *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 19-24 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A02/MF A01

On the boundary layer receptivity, the present paper describes the results of numerical simulations and laboratory experiments to clarify the condition under which external disturbances such as sound and free stream turbulence can excite Tollmien Schlichting (T-S) waves. The most important finding is that the unsteady pressure gradient on the wall imposed by the external disturbance need to have such proper spatial scales as to match lambda(sub TS), the wavelength of T-S wave to be excited. In this case, the unsteady pressure gradient induces the vortical wave of the proper scale and then T-S wave. Author (NASDA)

N93-16815# Keio Univ., Tokyo (Japan). Faculty of Science and Engineering.
BOUNDARY LAYER TRANSITION IN CORIOLIS FORCE FIELD [KORIORI RYOKU BA NI OKERU KYOUKAISOU SENI NI TSUITE]
Shigeaki Matsuda and Masaharu Matsubara *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 25-30 In JAPANESE (For primary document

see N93-16809 05-34)
Avail: CASI HC A02/MF A01

Experimental results on laminar turbulent transition of Blasius boundary layer subject to Coriolis force normal to the wall have been summarized. Coriolis force toward the wall enhance the three dimensional instability, resulting in the generation of counter rotating vortices and their secondary instability similar to those on a concave wall. Coriolis force directed outward from the wall, on the other hand, suppresses the three dimensionality and the transition is delayed, being associated with turbulent spots similar to the stationary boundary layer. Author (NASDA)

N93-16816# Kinki Univ., Kure (Japan). Faculty of Engineering.
LAMINAR TURBULENT TRANSITION OF A BOUNDARY LAYER BY DISTURBANCES IN THE MAIN STREAM [SHURYUU CHUU NO MIDARE NI YORU KYOUKAISOU SENI]
Yasuhiro Ouwa, Fujihiko Sakao, and Yoshihiro Matsuoka *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 31-33 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Development of disturbances in, and transition to turbulence of, a laminar boundary layer on a flat plate caused by free stream disturbances which are in turn introduced by a stationary circular cylinder or an impulsively swung wing near the layer is investigated. For most cases, transition to turbulence is observed at a place where disturbance by the cylinder or the wing supposedly first arrives at the boundary layer. Author (NASDA)

N93-16817# National Aerospace Lab., Tokyo (Japan).
THREE DIMENSIONAL BOUNDARY-LAYER TRANSITION ON A SWEPT CYLINDER [NANAME ENCHUU HYOUMEN NO SANJIGEN KYOUKAISOU SENI NI TSUITE]
Shouhei Takagi *In its* Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 35-37 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

An experiment has been carried out on three dimensional boundary layer transition along a swept cylinder with a diameter of 500 mm. The surface oil flow technique has been used to study the development of stationary vortices, which are characteristic of cross flow instability. Hot-wire anemometer surveys show that two kinds of time dependent disturbances grow prior to turbulent state. The first disturbance may be ascribed to Tollmien Schlichting (T-S) wave type instability. The following second with one order higher frequency than that of the first is caused by inflectional instability. There is no incongruity between experimental and current theoretical results. Author (NASDA)

N93-16818# Tohoku Univ., Sendai (Japan). Faculty of Engineering.
THREE DIMENSIONAL BOUNDARY-LAYER TRANSITION ON A SWEPT WING [KOUTAIYOKU MAWARI NO SANJIGEN KYOUKAISOU SENI]
Yasuaki Kohama *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 39-42 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Stability and transition experiments are conducted on a 45 deg swept airfoil in the Arizona State University (ASU) Unsteady Wind Tunnel. The pressure gradient is designed to obtain pure cross flow dominated transition where the instability occurs through cross flow vortices that are generic to three dimensional boundary layers. Flow visualization and hot-wires are used to show that transition to turbulence occurs through a high frequency, secondary instability that appears when the streamwise velocity profile is distorted by the stationary cross flow vortex. Multiple inflection points occur in the velocity profiles in very localized regions. These regions, characterized by spanwise velocity gradients that are the same magnitude as the normal to the wall gradients, are the source of the sawtooth transition patterns. The traveling cross flow waves, although strongly amplified, appear to play only a passive role in the transition process. Detailed roughness measurements near the attachment line account for the strongly three dimensional transition patterns that have been observed. Author (NASDA)

N93-16819# University of Electro-Communications, Chofu (Japan).
BOUNDARY-LAYER CONTROL ON A FREELY FALLING SPHERE [JIYUU RAKKA KYUUTAI NO KYOUKAISOU SEIGYO]
Yasuo Ikushima and Michio Ooji *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 43-47 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

The effect of surface roughness on a sphere at free fall has been investigated. The test sphere is of 100 mm in diameter, and is equipped with built-in processors such as a pressure sensor, a tension sensor, an amplifier, a memory, a power supply, and a Central Processing Unit (CPU). The surface roughness was obtained by a ring of phi 1 mm wire attached to the surface at angles phi(sub r) = 25 deg and 55 deg, respectively, measured from the stagnation point. In the case of phi(sub r) = 25 deg, the pressure distributions were same as a smooth sphere at Re less than or equal to 10(exp 5). In the case of phi(sub r) = 55 deg, on the other hand, the effects of trip ring were striking, indicating the laminar turbulent transition of the boundary layer at Re = 5 x 10(exp 4). Author (NASDA)

N93-16820# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF THERMAL CONVECTION IN A RECTANGULAR DUCT FLOW HEATED FROM ITS BOTTOM [KAMEN KANETSU KUKEI KAKUTORYUU NAI TAIRYUU NO SUUCHI SHIMYURESHON]
Kiyoshi Yamamoto, Iwao Hosokawa, and Yoshinori Tanaka *In its* Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer TTransition Sep. 1991 p 49-51 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Numerical simulation of thermal convection in a horizontal rectangular duct flow heated from its bottom and side walls is conducted using a method based on the Fourier spectral method. As a result, it is seen that the convective secondary flow is induced not only by the Rayleigh-Benard convection but by the natural convection near the side walls. When Reynolds numbers are rather larger values, 500 and 220, almost stationary longitudinal convective rolls are observed in the flow. On the other hand, when the Reynolds numbers are smaller values, 0 and 50, the rolls fluctuate chaotically in space and time; then the time averaged secondary flow is almost vanishing and the fluid temperature widely constant in the central part of the flow. Author (NASDA)

N93-16821# National Aerospace Lab., Tokyo (Japan).
STREAMWISE VORTICES AND DISTORTION OF VELOCITY DISTRIBUTION IN PARALLEL FLOWS [HEIKOURYUU CHUU NO TATEUZU TO SOKUKO BUNPU NO HENKEI]
Nobutake Itou *In its* Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 53-56 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Occurrence and important role of streamwise vortices in the instability and transition process are frequently pointed out. This study theoretically examines fundamental effects of the vortices placed in a very simple flow on the development of velocity distribution into three dimensional and inflectional forms. Author (NASDA)

N93-16822# Kyoto Inst. of Tech. (Japan).
TURBULENT SECONDARY FLOW AS A COHERENT STRUCTURE OF TURBULENT SHEAR FLOWS [RANRYUU NO CHITSUJO KOUZOU TOSHITE NO RANRYUU NIJIRYUU]
Tomomasa Tatsumi and Takahiro Yoshimura *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 57-61 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Turbulent secondary flow in a rectangular duct is a typical example of coherent structure in turbulent shear flows. The generation of the secondary flow is investigated in the framework of hydrodynamical stability of the corresponding laminar flow and the secondary flow is described as an equilibrium state of growing unstable disturbances. Author (NASDA)

N93-16823# University of Western Ontario, London. Dept. of Mechanical Engineering.
VARIATIONS IN THE CHARACTER OF GOERTLER INSTABILITY AS A FUNCTION OF MEAN FLOW VELOCITY DISTRIBUTION AND CURVATURE OF THE WALL
J. M. Floryan *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 63-66 (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Goertler instability occurs in the concave and convex wall cases provided that the mean flow has a nonmonotonic velocity distribution. Change from a monotonic to a nonmonotonic velocity distribution results in large changes in the character of the streamwise disturbance evolution. Author (NASDA)

N93-16824# Osaka Prefecture Univ., Sakai (Japan). Coll. of Engineering.
DEVELOPMENT OF WALL TURBULENCE STRUCTURE [KABE RANRYUU KOUZOU NO HATTATSU KATEI]
Masahito Asai *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 67-71 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

In order to investigate the mechanism of wall turbulence generation, a subcritical transition in a flat plate boundary layer was studied experimentally, through observing its nonlinear response to energetic hairpin eddies acoustically excited near the leading edge of boundary layer plate. In this paper, recent results on the development of wall turbulence structure in this transition is presented to reveal that the breakup of three dimensional wall shear layers (with streamwise vortices) into hairpin eddies leads to wall turbulence. The effect of riblets on the development of wall turbulence is also reported and discussed. Author (NASDA)

N93-16825# Wakayama Univ. (Japan).
MECHANISM OF THE MODE SELECTION IN BIFURCATIONS [SENI NI OKERU MODO NO SENTAKU]
Jirou Mizushima *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 73-75 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

The mechanism of the mode selection is investigated by a set of amplitude equations. It is shown that the most unstable mode is selected if there is no resonant interactions between the modes, whereas the wave number of the mode selected is shifted if there is resonant interactions. Author (NASDA)

N93-16826# Technische Univ., Berlin (Germany).
THE INFLUENCE OF DENSITY GRADIENT ON TURBULENT STRUCTURE IN THE 2D SHEAR FLOW [SENDAN RANRYUU NI TAISURU MITSUDO BUNPU NO EIKYOU]
K. Nottmeyer and Ryuuji Takaki *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 77-79 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

The plane turbulent mixing layer in the presence of density gradient was studied experimentally. Its behavior, such as the growth rate, depended critically on whether the density gradient had the same sign as the velocity gradient. A new technique to use the thermochromism for simultaneous and non intrusive measurements of velocity and temperature was introduced to the two dimensional mixing layer with temperature distribution. This technique has proved useful for this kind of research. Author (NASDA)

N93-16827# Tokuyama Coll. of Technology (Japan).
DRAG REDUCTION MECHANISM AND COHERENT STRUCTURE IN NEAR WALL TURBULENCE WITH RIBLETS [SANKAKU RIBURETTO NI YORU MASATSU TEIKOU KEIGEN KIKOU]
Hirofumi Oonari *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 81-84 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

The coherent structure in near wall region of turbulent channel flow with riblets are investigated using a visualization technique that utilizes fluorescent dye excited by an argon laser light sheet in the case of a low Reynolds number. The results indicate that the increase of viscous sublayer thickness on the riblet wall and the behavior of a pair of small streamwise vortices formed on the vertex of a triangle riblet play an important role in the drag reduction of near wall turbulence. Author (NASDA)

N93-16828# Tohoku Univ., Sendai (Japan). Faculty of Engineering.
A NEW PARAMETER FOR PREDICTING CROSSFLOW INSTABILITY [YOKO NAGARE FUANTEIBA WO KITEI SURU PARAMETA NI TSUITE]
Yasuaki Kohama *In* NAL, Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 85-87 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

Instability of boundary layers over a concave wall and a rotating disk which were thought to be essentially different in instability sources, are compared in order to investigate whether or not a single cross flow parameter can be defined. Using a newly defined cross flow parameter, prediction was attempted on a yawed cylinder boundary layer transition. By comparing the calculation with experiment, it was found that this parameter can document fairly well the onset condition of the cross flow instability. Author (NASDA)

N93-16829# National Aerospace Lab., Tokyo (Japan).
EXPERIMENTS ON SWEPT-WING BOUNDARY-LAYER TRANSITION [KOUTAIYOKU NI SOU SANJIGEN KYOUKAISOU SENI NI TSUITE]
Shouhei Takagi and W. S. Saric *In its* Proceedings of the 7th and 8th NAL Workshops on Investigation and Control of Boundary-Layer Transition Sep. 1991 p 89-91 In JAPANESE (For primary document see N93-16809 05-34)
Avail: CASI HC A01/MF A01

The three dimensional boundary layer experiments were conducted on a 45 deg swept wing in the Arizona State University (ASU) unsteady wind tunnel. Cross flow dominated transition was produced on a very smooth surface with contoured end liners to simulate infinite swept wing flow. The model surface was carefully polished and buffed up to plus or minus 3 micrometer to minimize roughness effects on transition. Fixed wavelength vortices, traveling wave and inflectional breakdown were subsequently observed prior to turbulent state as before, but the transition location moved further 10 percent to 20 percent downstream of the chord length. In order to control traveling wave and inflectional breakdown, two kinds of acoustic sounds, which tune up the traveling wave and breakdown, respectively, were introduced visualizing the surface flow via two or three dimensional roughness elements. No acoustic effect was observed in visualization. Author (NASDA)

N93-16837 Tel-Aviv Univ. (Israel). Dept. of Interdisciplinary Studies.
TWO-SCALE SOLUTION FOR THE MUTUAL COHERENCE FUNCTION IN THE PRESENCE OF TURBULENCE M.S. Thesis
Danny Cohen Sep. 1990 245 p
(ITN-93-85178) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

By using the two-scale embedding procedure, an expression has been obtained for the generalized two-position, two-frequency mutual-coherence function (MCF) of a wave in a turbulent medium. That result has been examined for initially plane wave, point source and Gaussian beams, obtaining simple expressions for the MCF for both the weak and strong scattering regions. Numerical results and comparisons with other results are also presented. Author (ISA)

N93-16838# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.
GAS BUBBLE MOTION IN LIQUID METALS AND AQUEOUS SOLUTIONS IN LOW GRAVITY ENVIRONMENTS Final Report
M. Salcudean, Z. Abdullah, M. Savage, and S. Lin 15 Apr. 1992 112 p Original contains color illustrations
(CTN-93-60607) Avail: CASI HC A06/MF A02; 12 functional color pages

Most of the low gravity experimental research in Canada is carried out using aicraft flying Keplarian parabolic trajectories under gravity levels on the order of 0.01 gravity. This gravity level can cause significant buoyancy effects in multi-phase or multi-component fluid flow experiments, if there are large density differences between the components. Three dimensional

mathematical models were developed to simulate gas bubble formation and transport in the low gravity environments typical of T-33 or KC-135 flights. The models developed can simulate gas bubble motion due to the combined effects of liquid motion and buoyancy effects. Ground based experiments examining gas bubble generation in tin were also conducted. A vibrating gas injector was used to generate gas bubbles in molten tin. The bubbles were then quenched in the molten tin, and their sizes were determined after cutting and polishing the quenched tin samples. The experiments showed that the theory to predict the bubble diameters, developed for water in a previous investigation, is also valid for tin. Gas bubbles of diameters on the order of 0.1 mm are generated in tin by using this method. Author (CISTI)

N93-16842# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

IMPROVED SHOCK-CAPTURING OF JAMESON'S SCHEME FOR THE NAVIER-STOKES EQUATIONS

J. W. vanderBurg, J. G. M. Kuerten, and P. J. Zandbergen 8 Mar. 1992 28 p Sponsored in part by NLR

(MEMO-1041; ETN-92-92469) Avail: CASI HC A03/MF A01

Jameson's scheme is a pseudo second order accurate scheme for solving discrete conservation laws. The scheme contains a nonlinear artificial dissipative flux which is designed to capture shocks. It was previously shown that for the discrete Euler equations the shock capturing of Jameson's scheme can be improved, at the expense of the calculation time, by replacing the Lax-Friedrichs' dissipative flux with Roe's dissipative flux. The study shows that the same results can be obtained for the discrete Navier-Stokes equations for two dimensional turbulent flow. For this purpose the ISNaS (Information System for flow simulation based on the Navier-Stokes equation) flow solver is appropriately modified. ESA

N93-16922# Sandia National Labs., Albuquerque, NM.

SAFSIM INPUT MANUAL: A COMPUTER PROGRAM FOR THE ENGINEERING SIMULATION OF FLOW SYSTEMS

D. Dobranich Sep. 1992 129 p

(Contract DE-AC04-76DP-00789)

(DE93-002738; SAND-92-0694) Avail: CASI HC A07/MF A02

SAFSIM (System Analysis Flow Simulator) is a FORTRAN computer program to simulate the integrated performance of systems involving fluid mechanics, heat transfer, and reactor dynamics. SAFSIM provides sufficient versatility to allow the engineering simulation of almost any system, from a backyard sprinkler system to a clustered nuclear reactor propulsion system. In addition to versatility, speed and robustness are primary goals of SAFSIM. SAFSIM contains three basic physics modules: (1) a one-dimensional finite element fluid mechanics module with multiple flow network capability; (2) a one-dimensional finite element structure heat transfer module with multiple convection and radiation exchange surface capability; and (3) a point reactor dynamics module with reactivity feedback and decay heat capability. SAFSIM can be used for gas (compressible) or liquid (incompressible) single-phase flow systems with primary emphasis on gases (or supercritical fluids). This document contains a description of all the information required to create an input file for SAFSIM execution. DOE

N93-16939*# Alabama Univ., Huntsville.

DEVELOPMENT OF GENERALIZED PRESSURE VELOCITY COUPLING SCHEME FOR THE ANALYSIS OF COMPRESSIBLE AND INCOMPRESSIBLE COMBUSTING FLOWS Final Report, 19 May 1989 - 18 May 1992

C. P. Chen and S. T. Wu 18 May 1992 72 p

(Grant NAG8-128)

(NASA-CR-191713; NAS 1.26:191713) Avail: CASI HC A04/MF A01

The objective of this investigation has been to develop an algorithm (or algorithms) for the improvement of the accuracy and efficiency of the computer fluid dynamics (CFD) models to study the fundamental physics of combustion chamber flows, which are necessary ultimately for the design of propulsion systems such as SSME and STME. During this three year study (May 19, 1978 - May 18, 1992), a unique algorithm was developed for all speed flows. This newly developed algorithm basically consists of two pressure-based algorithms (i.e. PISOC and MFICE). This PISOC is a non-iterative scheme and the FICE is an iterative scheme where PISOC has the characteristic advantages on low and high speed flows and the modified FICE has shown its efficiency and accuracy to compute the flows in the transonic region. A new algorithm is born from a combination of these two algorithms. This newly developed algorithm has general application in both time-accurate and steady state flows, and also was tested extensively for various flow conditions, such as turbulent flows, chemically reacting flows, and multiphase flows. Author

N93-17038# Argonne National Lab., IL.

BOILING HEAT TRANSFER OF REFRIGERANT R-113 IN A SMALL-DIAMETER, HORIZONTAL TUBE

M. W. Wambsganss, J. A. Jendrzejczyk, T. N. Tran, and D. M. France Jan. 1992 39 p

(Contract W-31-109-eng-38)

(DE93-002351; ANL-92/12) Avail: CASI HC A03/MF A01

Results of a study of boiling heat transfer from refrigerant R-113 in a small diameter (2.92 mm) tube are reported. Local heat transfer coefficients over a range of heat fluxes, mass fluxes, and equilibrium mass qualities were measured. The measured coefficients were used to evaluate eight different heat transfer correlations, some of which have been developed specifically for refrigerants. High heat fluxes and low flow rates are inherent in small channels, and this combination results in high boiling numbers. The high boiling number of the collected data shows that the nucleation mechanism was dominant. As a result, the two-phase correlations that predicted this dominance also predicted the data best if they also properly modeled the physical parameters. The correlations of Lazarek and Black and of Shah, as modified in this study, predicted the data very well. It is also shown that a simple form, suggested by Stephan and Abdelsalam for nucleate boiling, correlates the data equally well. This study is part of a research program in multiphase flow and heat transfer, with the overall objective of developing validated design correlations and predictive methods that will facilitate the design and optimization of compact heat exchangers for use with environmentally acceptable alternatives for chlorofluorocarbon (CFC) refrigerants and refrigerant mixtures. DOE

N93-17039*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

FLUID SEPARATOR Patent Application

Glen A. Robertson, inventor (to NASA) 9 Oct. 1992 11 p

(NASA-Case-MFS-28658-1; NAS 1.71:MFS-28658-1;

US-Patent-Appl-SN-958843) Avail: CASI HC A03/MF A01

A fluid separator for separating particulate matter such as contaminates is provided which includes a series of spiral tubes of progressively decreasing cross sectional area connected in series. Each tube has an outlet on the outer curvature of the spiral. As fluid spirals down a tube, centrifugal force acts to force the heavier particulate matter to the outer wall of the tube, where it exits through the outlet. The remaining, and now cleaner, fluid reaches the next tube, which is smaller in cross sectional area, where the process is repeated. The fluid which comes out the final tube is diminished of particulate matter. NASA

N93-17046# Stanford Univ., CA. Dept. of Chemical Engineering.

FUNDAMENTAL STUDIES OF FLUID MECHANICS AND STABILITY IN POROUS MEDIA

G. M. Homsy Jul. 1992 9 p

(Contract DE-FG03-87ER-13673)

(DE93-002519; DOE/ER-13673/T3) Avail: CASI HC A02/MF A01

We have been active in four areas: Numerical and analytical studies of viscous fingering in miscible displacements, including non-monotonic mobility profiles; numerical and analytical studies of the effect of non-Newtonian fluid characteristics on instabilities; experimental studies of instabilities of moving contact lines for Newtonian and non-Newtonian fluids; and studies of natural convective energy transport due to time-dependent body forces. DOE

N93-17534# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.

COMPUTING BRINE TRANSPORT IN POROUS MEDIA WITH AN ADAPTIVE-GRID METHOD

R. A. Trompert, J. G. Verwer, and J. G. Blom Jan. 1992 27 p Sponsored by Netherlands Ministry of Economic Affairs

(CWI-NM-R9201; ETN-92-92510) Copyright Avail: CASI HC A03/MF A01

An adaptive grid finite difference method was applied to a model for

nonisothermal, coupled flow and transport of brine in porous media. In the vicinity of rock salt formations the salt concentration in the fluid becomes large, giving rise to disparate scales in the salt concentration profiles. A typical situation, that of a sharp fresh salt water interface that moves in time, is considered. In such situations adaptive grid methods are more effective than standard fixed grid methods, since they refine the space grid locally and hence, provide for substantial reduction in number of grid points, memory use, and central processing unit time. The adaptive grid method considered, is a static, local uniform grid refinement method. Its main feature is that it is integrated on nested sequences of locally uniformly refined cartesian space grids, which are automatically adjusted in time to follow rapid spatial transitions. Variable time steps are used to cope with rapid temporal transitions, including a fast march to possible steady state solutions. For time stepping the implicit, second order Backward Differentiation Formula (BDF) scheme is used. Two specific example problems are numerically illustrated. The main physical properties involved are advection and dispersion, and in the case of dominant advection sharp fresh salt water interfaces arise. ESA

N93-17546# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
NUMERICAL SOLUTIONS OF THE EULER EQUATIONS FOR STEADY FLOW PROBLEMS
A. Eberle, A. Rizzi, and E. H. Hirschel 25 Oct. 1992 454 p Submitted for publication
(MBB-FE-202-S-PUB-473-A; ETN-92-92573) Copyright Avail: CASI HC A20/MF A04

The basics of numerical solution methods for the Euler equations of fluid flow are presented. At the center are finite volume methods, both with central and with upwind differencing. The following are discussed: the properties of the Euler equations, fundamentals of discrete solution methods, the finite volume concept, centered differencing, principles of upwinding, and convergence to steady state. Emphasis is put on the modeling of vortex flows. The vorticity production is explained, and rules are given for the use of Euler solvers in engineering work, also for the coupling with viscous models. A large number of practical application examples demonstrates the versatility and the potential of present day Euler method in science and industry. ESA

N93-17550# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.
RESPONSE OF A VISCOUS LIQUID COLUMN WITH ANCHORED EDGES TO AXIAL EXCITATIONS
Helmut F. Bauer 1991 37 p
(LRT-WE-9-FB-7-1991; ETN-92-92585) Avail: CASI HC A03/MF A01

The natural damped frequencies and the response of a viscous liquid column to axial excitation was determined analytically. For the analytical treatment, the anchored edge condition at the top and the bottom disc of the liquid column was observed (stuck edge condition). The free liquid surface elevation and the radial and axial velocity distribution were presented for various surface tension parameters, aspect ratios, and at various locations inside and along the liquid bridge as functions of the forcing frequency parameters. It could be noticed that due to viscosity, the resonance amplitudes are finite and that the lowest resonance is sharply tuned. ESA

N93-17552# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.
MARANGONI-CONVECTION IN A ROTATING LIQUID CONTAINER
Helmut F. Bauer 1991 112 p
(LRT-WE-9-FB-14-1991; ETN-92-92587) Avail: CASI HC A06/MF A02

Marangoni convection, in a partially filled and constantly spinning container in zero gravity conditions, was treated analytically for a directly imposed temperature gradient upon the free liquid surface and also for a constant but different temperature at the upper and lower disc wall. The streamfunction and circulation were obtained, from which the velocity distribution could be determined. ESA

N93-17557# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
ADAPTIVE MULTIGRID FOR THE STEADY EULER EQUATIONS
H. T. M. vanderMaarel Dec. 1991 13 p
(Contract AERO-0003C)
(CWI-NM-R9122; ETN-92-92508) Copyright Avail: CASI HC A03/MF A01

A method to solve the steady Euler equations by using an upwind finite volume discretization on a locally refined grid and multigrid convergence acceleration is presented. The locally refined grid consists of grids in a locally nested sequence. The discretization is described with emphasis on grid interfaces and accuracy. The multigrid algorithm is described and some computational examples are given. ESA

N93-17604# Argonne National Lab., IL. Energy Systems Div.
INFLUENCE OF PRANDTL NUMBER AND EFFECTS OF DISRUPTION SHAPE ON THE PERFORMANCE OF ENHANCED TUBES WITH THE SEPARATION AND REATTACHMENT MECHANISM
B. Arman and T. J. Rabas Apr. 1992 126 p
(Contract W-31-109-eng-38)
(DE93-003624; ANL/ESD-16) Avail: CASI HC A07/MF A02

The pressure-drop and heat-transfer performance of an enhanced tube with transverse disruptions can be predicted with a numerical modeling method, an accomplishment not previously achieved. Two computer codes were employed to achieve this goal: an orthogonal code and a nonorthogonal, body-fitted code. The turbulence closure was achieved with a two-layer turbulence model. The orthogonal computer code was used to determine the influence of the Prandti number. The numerical simulations demonstrated that six distinct regions exist and that three zones dominate the thermal performance. The nonorthogonal, body-fitted numerical code was used to determine the thermohydraulic performance of enhanced tubes with transverse, periodic sine-, semicircle-, arc-, and trapezoid-shaped disruptions. The research showed that there was a trade-off between the heat-transfer and pressure-drop performances when the disruption shape becomes more contoured, and that the local heat transfer is strongly dependent on the shape in the vicinity of the disruption, but it is less dependent in the downstream recirculation region and in the boundary-layer development zone. DOE

N93-17683# Mississippi State Univ., Mississippi State.
NUMERICAL SOLUTION AND ALGORITHM ANALYSIS FOR THE UNSTEADY NAVIER-STOKES EQUATIONS ON DYNAMIC MULTIBLOCK GRIDS INCLUDING CHEMICAL EQUILIBRIUM, VOLUME 2 Final Report, Jun. 1989 - Jun. 1992
J. M. Janus, C. F. Cox, A. Arabshahi, P. Cinella, and D. L. Whitfield Oct. 1992 158 p
(Contract F08635-89-C-0208)
(AD-A257702; WL-TR-92-7044-Vol-2) Avail: CASI HC A08/MF A02

This is a two volume final report for the research entitled Computation of Hypersonic Interference Flowfields. Volume I involves the numerical solution of the three-dimensional unsteady Euler and Navier-Stokes equations for a calorically perfect gas. This volume involves the development of techniques for the solution of three-dimensional inviscid and viscous hypersonic flows in chemical equilibrium. This research addresses the numerical formation and solution of the equations as well as an analysis of the optimization of the numerical solution algorithm used to solve the equations. Selected results of numerous hypersonic flow computations including computations of heat transfer to bodies with different nose shapes are presented. GRA

N93-17736# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
ASYMPTOTIC PROFILES WITH FINITE MASS IN ONE-DIMENSIONAL CONTAMINANT TRANSPORT THROUGH POROUS MEDIA: THE FAST REACTION CASE
R. E. Grundy (Saint Andrew's Univ., Scotland), C. J. vanDuijn, and C. N. Dawson (Rice Univ., Houston, TX.) 1992 49 p
(Contract SC1-019-C(TT))
(Rept-92-30; ETN-93-93122) Copyright Avail: CASI HC A03/MF A01

The large time behavior of solutions of a given convection-dispersion equation with nonlinear capacity, subject of a given initial condition, is addressed. The problem reflected in the equation and initial condition arises as a model for the one dimensional transport of a solute, with scaled concentration greater than or equal to zero, through a porous medium. In this model, the solute is assumed to undergo equilibrium adsorption with the porous matrix. An integrability condition is given which implies that

initially, the total mass, both in solution and adsorbed, is finite. The physical background of the problem is discussed and the equation is derived. Some analytical properties of solutions are given. Findings are compared to referenced analytical results. The asymptotic form for pulse type solutions given a given condition is considered. The outer solutions and boundary layer solutions are discussed. The asymptotic profiles are compared with the numerical solution of the first problem. An algorithm based on a higher order Godunov approach is discussed. GRA

N93-17742# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France). Service de Recherche en Aerothermique et Turbine.
GLOBAL FLOW CHARACTERISTICS ON A CURVED CHANNEL. GOERTLER INSTABILITY POINT [CARACTERISTIQUES GLOBALES DE L'ECOULEMENT DANS UN CANAL COURBE. SIEGE DE L'INSTABILITE DE GOERTLER]
P. Petitjeans, D. Vallet (Ecole Superieure de Physique et de Chimie Industrielles, Paris, France), and J. E. Westfreid (Ecole Superieure de Physique et de Chimie Industrielles, Paris, France) 1991 4 p In FRENCH Presented at 10th Congres Francais de Mecanique, Paris, France, 2-6 Sep. 1991
(DS-2141; ETN-93-93379) Avail: CASI HC A01/MF A01

Global flow characteristics in a curved low speed hydrodynamic channel which was specially designed to study Goertler instability are presented. Other phenomena which appear in the channel, such as recirculation, wall effects and boundary layer deviations, which have an effect on the evolution of this instability, are taken into consideration. The investigation techniques used were laser fluorescence visualization and laser velocimetry. ESA

N93-17761# Clarkson Univ., Potsdam, NY. Dept. of Chemical Engineering.
LIFT AND DRAG FORCES ON DROPLETS AND PARTICLES IN WALL-BOUNDED SHEAR FLOWS
J. B. McLaughlin 1992 10 p
(Contract DE-FG02-88ER-13919)
(DE93-002678; DOE/ER-13919/5) Avail: CASI HC A02/MF A01

This project has two goals: to calculate the lift force on a spherical droplet or particle that translates through a shear flow; and to measure the inertial migration velocity that is caused by the lift force. The focus of the study is on a range of Reynolds numbers that has been shown to be of importance in the inertial deposition of aerosols from turbulent shear flows. Aspects of current technical progress summarized are the asymptotic analysis, computer simulations, and experimental measurements. Future plans and resulting publications are given. DOE

N93-17789# Mississippi State Univ., Mississippi State.
NUMERICAL SOLUTION AND ALGORITHM ANALYSIS FOR THE UNSTEADY NAVIER-STOKES EQUATIONS ON DYNAMIC MULTIBLOCK GRIDS, VOLUME 1 Final Report, Jun. 1989 - Jun. 1992
J. M. Janus, A. Arabshahi, and D. L. Whitfield Oct. 1992 80 p
(Contract F08635-89-C-0208)
(AD-A257522; WL-TR-92-7044-Vol-1) Avail: CASI HC A05/MF A01

This is a two volume final report for the research entitled Computation of Hypersonic Interference Flowfields. This volume involves the numerical solution of the three-dimensional unsteady Euler and Navier-Stokes equations for a calorically perfect gas. Volume 2 involves the development techniques for the solution of three-dimensional inviscid and viscous hypersonic flows in chemical equilibrium. This report addresses the numerical formulation and solution of the equations as well as an analysis of the optimization of the numerical solution algorithm used to solve the equations. Selected results of numerous hypersonic flow computations-including computations of heat transfer to bodies with different nose shapes-are presented. GRA

N93-15763# Aeronautical Research Inst. of Sweden, Bromma.
GENERALISED DAMPING IN FLUID STRUCTURE INTERACTION ANALYSES USING MODAL SYNTHESIS
Peter Goeransson and Jan Brandt *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 807-812 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15780# METRAVIB, Lyon (France).
FLUID-STRUCTURE INTERACTION APPLIED TO THE ANALYSIS OF A TEST SANDWICH PANEL TYPICAL FOR SPATIAL APPLICATIONS
D. VaucherdelaCroix, L. Perret (Centre National d'Etudes Spatiales, Toulouse, France), and J. M. Parot (IMDYS, Brioude, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 933-937 Sponsored by CNES (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-16771*# Clarkson Univ., Potsdam, NY. Dept. of Mechanical and Aeronautical Engineering.
NEAR-WALL RECONSTRUCTION OF HIGHER ORDER MOMENTS AND LENGTH SCALES USING THE POD
Mark N. Glauser *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 116-120 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16786*# Alabama Univ., Tuscaloosa. Dept. of Mechanical Engineering.
COMPARISON OF METHODOLOGIES FOR DESCRIBING RELAXATION IN NONEQUILIBRIUM GASEOUS SYSTEMS
Willard C. Schreiber *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 169-170 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16792*# Tuskegee Inst., AL. Dept. of Aerospace and Mechanical Engineering.
STUDIES ON SPECTRAL ANALYSIS OF RANDOMLY SAMPLED SIGNALS: APPLICATION TO LASER VELOCIMETRY DATA
David Sree *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 180-182 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17289*# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Mechanical Engineering.
CFD ANALYSIS ON CONTROL OF SECONDARY LOSSES IN STME LOX TURBINES WITH ENDWALL FENCES
Mingking K. Chyu *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17329*# Kansas Univ., Lawrence. Dept. of Mechanical Engineering.
ACCELERATION OF FDNS FLOW SIMULATIONS USING INITIAL FLOWFIELDS GENERATED WITH A PARABOLIZED NAVIER-STOKES METHOD
Peter W. TenPas *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17334*# Alabama A & M Univ., Huntsville. Dept. of Physics.
NATURE OF FLUID FLOWS IN DIFFERENTIALLY HEATED CYLINDRICAL CONTAINER FILLED WITH A STRATIFIED SOLUTION
Jai-Ching Wang *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N93-15662# Los Alamos National Lab., NM.
HIGH SPEED CINERADIOGRAPHY USING ELECTRONIC IMAGING
J. P. Lucero, D. A. Fry, W. E. Gaskill, R. L. Henderson, T. R. Crawford, and N. E. Carey 1992 11 p Presented at the 20th International Congress on High Speed Photography and Photonics, Victoria, Ontario, 25-26 Sep. 1992
(Contract W-7405-eng-36)
(DE92-040366; LA-UR-92-2836; CONF-9209188-2) Avail: CASI HC A03/MF A01

The Los Alamos National Laboratory has constructed and is now operating a cineradiography system for imaging and evaluation of ballistic interaction events at the 1200 meter range of the Terminal Effects Research and Analysis (TERA) Group at the New Mexico Institute of Mining and Technology. Cineradiography is part of a complete firing, tracking, and analysis system at the range. The cine system consists of flash x-ray sources illuminating a one-half meter by two meter fast phosphor screen which is viewed by gated-intensified high resolution still video cameras via turning mirrors. The entire system is armored to protect against events containing up to 13.5 kg of high explosive. Digital images are available for immediate display and processing. The system is capable of frame rates up to 10(exp 5)/sec for up to five total images. DOE

N93-15665# Brookhaven National Lab., Upton, NY.
INDEPENDENT VERIFICATION OF TANK VOLUME MEASUREMENTS BY PRESSURE-VOLUME AUTHENTICATION
S. C. Suda and B. Keisch 1992 6 p Presented at the Inst. of Nuclear Materials Management Annual Meeting, Orlando, FL, 19-22 Jul. 1992
(Contract DE-AC02-76CH-00016)
(DE92-040680; BNL-47071; TSO-92-1; CONF-9207102-68) Avail: CASI HC A02/MF A01

Brookhaven National Laboratory has developed a portable pressure-volume authenticator as a standard and means of checking the functionality and quality of bubbler-probe volumetric devices. The pressure-volume authenticator (PVA) consists of an automated electromanometer system that is controlled by a laptop computer, and a transportable volumetric artifact. A portable pressure gage is connected, via a scanivalve, to the operator's bubbler-probe system and independently measures all bubbler probes. The transportable volumetric artifact is a one-meter high vessel equipped with bubble-probes, computer controlled air-purge rotameters, and platinum resistance (RTD) thermometer. High quality measurements are obtained by use of a fast sampling technique and sophisticated software developed under this program. The computer software performs the following functions: (1) instrument control; (2) data acquisition; (3) on-line graphical and numerical display of measurement data; and (4) detailed data analysis. The device also may provide hands-on training for inspectors and plant operators in high quality volumetric data collection and analysis. A field demonstration of the automated electromanometer system was conducted on the PETRA input accountancy tank, JRC-Ispra in November 1991. DOE

N93-15688# Naval Postgraduate School, Monterey, CA.
DEVELOPMENT OF AN AUTOMATED SCANNING MONOCHROMATOR FOR SENSITIVITY CALIBRATION OF THE MUSTANG INSTRUMENT
M.S. Thesis
Thane D. Rivers Jun. 1992 57 p
(AD-A256830) Avail: CASI HC A04/MF A01

An Automated Scanning Monochromator was developed using: an Acton Research Corporation (ARC) Monochromator, Ealing Photomultiplier Tube and a Macintosh PC in conjunction with LabVIEW software. The LabVIEW Virtual Instrument written to operate the ARC Monochromator is a mouse driven user friendly program developed for automated spectral data measurements. Resolution and sensitivity of the Automated Scanning Monochromator System were determined experimentally. The Automated monochromator was then used for spectral measurements of a Platinum Lamp. Additionally, the reflectivity curve for a BaSO4 coated screen has been measured. Reflectivity measurements indicate a large discrepancy with expected results. Further analysis of the reflectivity experiment is required for conclusive results. GRA

N93-15716*# Galileo Electro-Optics Corp., Sturbridge, MA.
DEVELOPMENT OF MICROCHANNEL PLATES IN ADVANCED WIND-TUNNEL INSTRUMENTATION
W. Bruce Feller Feb. 1990 151 p
(Contract NAS1-18482; SBIR-08.13-9191; RTOP 506-43-31-05)
(NASA-CR-181947; NAS 1.26:181947) Avail: CASI HC A08/MF A02

Microchannel plate (MCP) electron multiplier dynamic range has been increased 3 to 4 orders of magnitude at ambient temperatures, through enhanced input count rate capability and reduced background or 'dark' noise. The previous upper limit of roughly 10(exp 7) - 10(exp 8) cm(exp -2)s(exp -1) at ambient has been extended to levels approach 10(exp 10) cm(exp -2)s(exp -1) under continuous dc operation. The lower limit, previously set by an irreducible background component (approximately 0.6 cm(exp -2)s(exp -1)), has been lowered to the cosmic ray limit of .01 cm(exp -2)s(exp -1). The high end improvement was achieved by conductively cooling a very low resistance MCP by bonding it to a heat sink, while maintaining pulse-counting operation with multianode readouts. The low-end improvement was achieved by removing all radioisotopes from the MCP matrix glass. The detectors will benefit optical and mass spectrometry, flow visualization, plasma diagnostics, magnetometry, and other high signal flux applications. Very low MCP background noise will benefit X-ray and UV astronomy, medical imaging, trace isotope mass spectrometry, and other applications where the signal flux is often extremely low. Author

N93-15831# Sandia National Labs., Albuquerque, NM.
PULSED HOLOGRAPHY FOR HYPERVELOCITY IMPACT DIAGNOSTICS
J. A. Ang, B. D. Hansche, C. H. Konrad, W. C. Sweatt, S. M. Gosling, and R. J. Hickman 1992 14 p Presented at the Hypervelocity Impact Symposium, Austin, TX, 17-20 Nov. 1992
(Contract DE-AC04-76DP-00789)
(DE92-040259; SAND-91-2871C; CONF-921162-6) Avail: CASI HC A03/MF A01

Pulsed holography is being developed to meet two principal objectives. The first objective is to quantify the three dimensional characteristics of hypervelocity impact events, and the second is to provide a diagnostic with the ability to capture high fidelity information for the validation of sophisticated three-dimensional hydrocodes. The holographic system uses a Q-switched, seeded, frequency-doubled Nd-YAG laser which produces 5 ns, 750 mJ, coherent pulses at 532 nm. Holographic images were captured of the back-surface debris bubble from 4 km/s perforating impacts and crater ejecta from 2 km/s non-perforating impacts. A prototype holographic reconstruction and image analysis system has been assembled that provides the ability to measure the structure and individual particles produced in a hypervelocity impact event. The estimated image resolution of this system is 10 to 20 microns; however, this level of performance has not yet been demonstrated. DOE

N93-16150# Oak Ridge National Lab., TN.
ATOMIC RESOLUTION IMAGING AND ANALYSIS WITH THE STEM
S. J. Pennycook, D. E. Jesson, M. F. Chisholm, and N. D. Browning Aug. 1992 9 p Presented at the 13th International Congress on X Ray Optics and Microanalysis, Manchester (United Kingdom), 31 Aug. - 4 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE92-041304; CONF-920839-1) Avail: CASI HC A02/MF A01

Recent instrumental developments in the high-resolution scanning transmission electron microscope (STEM) offer the promise of combining incoherent imaging and spectroscopic analysis at atomic resolution, even in the presence of strong dynamical diffraction of low order diffracted beams. This extends the realm of intuitive structure determination to substantially greater thicknesses and higher resolution than conventional methods. Recent applications to the study of interfacial structures and atomistic mechanisms of growth are described, along with indications of future directions. DOE

N93-16219# Stanford Linear Accelerator Center, CA.
FIRST RESULTS FROM THE SLD SILICON CALORIMETERS
S. C. Berridge (Tennessee Univ., Knoxville.), W. M. Bugg (Tennessee Univ., Knoxville.), R. S. Kroeger (Tennessee Univ., Knoxville.), A. W. Weidemann (Tennessee Univ., Knoxville.), S. L. White (Tennessee Univ., Knoxville.), J. E. Brau (Oregon Univ., Eugene.), R. Frey (Oregon Univ., Eugene.), K. Furuno (Oregon Univ., Eugene.), J. Huber (Oregon Univ., Eugene.), and H. Hwang (Oregon Univ., Eugene.) et al Jul. 1992 7 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract DE-AC03-76SF-00515)
(DE93-001805; SU-SLAC-PUB-5694; CONF-911106-97) Avail: CASI HC A02/MF A01

The small-angle calorimeters of the SLD were successfully operated during the recent SLC engineering run. The Luminosity Monitor and Small-Angle Tagger (LMSAT) covers the angular region between 28 and 68 milliradians from the beam axis, while the Medium-Angle Silicon Calorimeter (MASC) covers the 68-190 milliradian region. Both are silicon-tungsten sampling calorimeters; the LMSAT employs 23 layers of 0.86 X(sub 0) sampling, while the MASC has 10 layers of 1.74 X(sub 0) sampling. We present results from the first run of the SLC with the SLD on beamline. DOE

N93-16280# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
SINGLE AND CROSS HOT WIRE ANEMOMETRY IN INCOMPRESSIBLE FLOW
F. J. M. Wubben Dec. 1991 252 p Sponsored in part by NLR
(LR-663; ETN-92-92866) Avail: CASI HC A12/MF A03

An overview of the data acquisition and reduction procedures for constant temperature single and cross hot wire measurements is given. In the framework of a boundary layer study, the available hot wire procedures were reviewed. A number of advantages are introduced by digital sampling. The calibrated nonlinear voltage velocity relationship of the hot wire anemometer is stored in the computer and all voltage samples are one after the other reduced to instantaneous velocity samples. In other words, the velocity signal is available in digital samples, so statistical averages, autocorrelation, spectra, etc. can be calculated where in the past electronic circuitry was necessary. Fundamental items concerning hot wire anemometry are discussed, dealing with the basic relations, corrections for temperature drift, frequency response, heat conduction to wire supports, and the spatial resolution of hot wires. Frequently used calibration and measurement procedures for single and cross wire probes are given together with test set up and data acquisition. Results of tests with the proposed hot wire system were given along with conclusions and recommendations. ESA

N93-16359# EG and G Energy Measurements, Inc., Los Alamos, NM.
MILLISECOND READOUT CCD CAMERA
M. Prokop, T. W. McCurnin, and G. Stradling (Los Alamos National Lab., NM.) 1992 15 p Presented at the 20th International Congress on High Speed Photography and Photonics, Victoria, British Columbia, 25-26 Sep. 1992
(Contract DE-AC08-88NV-10617)
(DE93-000694; EGG-10617-5100; CONF-9209188-5) Avail: CASI HC A03/MF A01

We have developed a prototype of a fast-scanning CCD readout system to record a 1024 x 256 pixel image and transport the image to a recording station within 1 ms of the experimental event. The system is designed to have a dynamic range of greater than 1000 with adequate sensitivity to read single-electron excitations of a CRT phosphor when amplified by a microchannel plate image intensifier. This readout camera is intended for recording images from oscilloscopes, streak, and framing cameras. The sensor is a custom CCD chip, designed by LORAL Aeroneutronics. This CCD chip is designed with 16 parallel output ports to supply the necessary image transfer speed. The CCD is designed as an interline structure to allow fast clearing of the image and on-chip fast shuttering. Special antiblooming provisions are also included. The camera is designed to be modular and to allow CCD chips of other sizes to be used with minimal reengineering of the camera head. DOE

N93-16453*# Alabama Univ., Huntsville. Consortium for Holography, Applied Mechanics and Photonics.
ENDOSCOPIC MEASUREMENTS USING A PANORAMIC ANNULAR LENS Final Report
John A. Gilbert and Donald R. Matthys (Marquette Univ., Milwaukee, WI.) Sep. 1992 43 p
(Contract NAS8-36955)
(NASA-CR-191727; NAS 1.26:191727) Avail: CASI HC A03/MF A01

The objective of this project was to design, build, demonstrate, and deliver a prototype system for making measurements within cavities. The system was to utilize structured lighting as the means for making measurements and was to rely on a stationary probe, equipped with a unique panoramic annular lens, to capture a cylindrical view of the illuminated cavity. Panoramic images, acquired with a digitizing camera and stored in a desk top computer, were to be linearized and analyzed by mouse-driven interactive software. Author

N93-16458*# Alabama Univ., Huntsville. Dept. of Physics.
POLARIZATION ANALYSIS OF A BALLOON-BORNE SOLAR MAGNETOGRAPH Final Report
Daniel J. Reiley and Russell A. Chipman 1987 43 p
(Contract NAS8-38609)
(NASA-CR-191270; NAS 1.26:191270) Avail: CASI HC A03/MF A01

The main text of the report contains the particular results of our research which relate to the Experimental Vector Magnetograph (EXVM) and the Balloon-borne Vector Magnetograph (BVM). A brief overview of which elements in the EXVM and BVM that are relevant to this polarization analysis are presented. The possible meaning of the 10(exp -5) polarization specification for the BVM is discussed qualitatively. A recommendation of which polarization specification is most relevant for the BVM is provided. A diattenuation budget for the various surfaces in the BVM which will allow the polarization specification to be met is discussed. An explanation of the various coating specifications which are recommended is presented. Optical design of the EXVM and coating specification sheets for the BVM are presented. The appendices of this report contain the more general results of our research on the general topic of polarization aberrations. A general discussion of polarization aberration theory, in terms of the SAMEX solar magnetograph, and rigorous derivations for the Mueller matrices of optical systems are also presented in the appendices. Author

N93-16492 Department of the Navy, Washington, DC.
INFRARED FIBER-OPTICAL TEMPERATURE SENSOR Patent
James E. Bryant, investor (to Navy), John E. Bennett, inventor (to Navy), and William H. Pinkston, inventor (to Navy) 8 Sep. 1992 10 p Filed 12 Aug. 1991
(AD-D015495; US-Patent-5,145,257; US-Patent-Appl-SN-744046; US-Patent-Class-374-131) Avail: US Patent and Trademark Office

A temperature sensor comprising a probe, infrared fibers, super-cooled detectors and their associated electronics, and a computer for determining the temperature from the output of the electronics is presented. Photons from a heat source are collected by the infrared fibers and transmitted to the detectors where they are amplified by the electronics. A voltage is then outputted which represents measured temperature. The voltage is sampled by the computer where it is converted to temperature by use of computer algorithms. GRA

N93-16520 Department of the Navy, Washington, DC.
DEVICE FOR SENSING UNWANTED ELECTRIC AND MAGNETIC FIELDS IN A REMOTE SENSOR ELECTRICAL LEAD Patent
Robert G. Blank, inventor (to Navy) and Steven K. Clark, inventor (to Navy) 4 Aug. 1992 4 p Filed 27 Aug. 1990
(AD-D015508; US-Patent-5,136,241; US-Patent-Appl-SN-573084; US-Patent-Class-324-225) Avail: US Patent and Trademark Office

A device is provided for measuring unwanted electric and magnetic field induced voltages in a test lead of a remote measurement sensor. A test lead is encased within a magnetic shielding conduit and is electrically connected to a remote sensor. Another electrical lead, identical to the test lead and also encased within the magnetic shielding conduit, is terminated by a short circuit in the vicinity of the sensor. This electrical lead travels through the same environment as the test lead on its way to the measuring equipment. Electromagnetic field interference along the path of this electrical

lead is an indication of the electromagnetic field interference along the path of the test lead. GRA

N93-16564# Technische Univ., Delft (Netherlands). Electromagnetic Research Lab.

REPRODUCTION OF DIGITAL SIGNALS IN MAGNETIC RECORDING: A THEORETICAL STUDY Ph.D. Thesis

Dirk Quak 1992 226 p

(ISBN-90-6275-757-X; ETN-92-92792) Copyright Avail: CASI HC A11/MF A03

Some fundamental aspects of the process of magnetic information storage are described. The purpose of magnetic information storage is to accomplish a one to one correspondence between a time dependent signal that contains any type of information and that is available at a single position in space on one hand and a time independent spatial pattern of permanent magnetization on the recording medium on the other hand, and vice versa. Special attention is given to the read process in magnetic recording theory. The read process can be described by the quasi static approximation to the electromagnetic field equations. The basic relations for the quasi static magnetic field are presented. The integral relations of the Green type for the magnetic field strength and the magnetic flux density in the quasi static approximation are discussed. The way in which the quasi static magnetic field in multilayered structures can be calculated, is outlined. The reproduction process is analyzed in the two dimensional approximation. It is shown that the phenomenon of gap nulls is not restricted to an inductive ring head with a small gap, but that it also shows up when a single pole head is used. Geometries that markedly differ from the inductive ring and single pole heads are analyzed. ESA

N93-16659*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.

RECOGNITION OF FIDUCIAL MARKS APPLIED TO ROBOTIC SYSTEMS Thesis

Wayne D. Georges Aug. 1991 73 p

(Grant NAGw-1333)

(NASA-CR-191857; NAS 1.26:191857; CIRSSE-103) Avail: CASI HC A04/MF A01

The objective was to devise a method to determine the position and orientation of the links of a PUMA 560 using fiducial marks. As a result, it is necessary to design fiducial marks and a corresponding feature extraction algorithm. The marks used are composites of three basic shapes, a circle, an equilateral triangle and a square. Once a mark is imaged, it is thresholded and the borders of each shape are extracted. These borders are subsequently used in a feature extraction algorithm. Two feature extraction algorithms are used to determine which one produces the most reliable results. The first algorithm is based on moment invariants and the second is based on the discrete version of the psi-s curve of the boundary. The latter algorithm is clearly superior for this application. Author

N93-16745# Thomson and Nielsen Electronics, Ottawa (Ontario).

FEASIBILITY ASSESSMENT AND APPLICATIONS DEVELOPMENT OF A RADIOBIOLOGICAL DOSIMETER FOR SPACE APPLICATIONS, PHASE 2 Final Report

Gary MacRay 1 Nov. 1991 18 p

(CTN-93-60609) Avail: CASI HC A03/MF A01

Radiobiological dosimeters were developed and evaluated for space applications. Basic properties and sensitivities of metal oxide semiconductor (MOS) dosimeters were studied and a flexible MOS dosimeter 12 cm long and 3 mm wide was developed for radiobiology experiments. Such a dosimeter could be placed inside biological specimens or incorporated in space suits. A heavy particle detector to detect galactic cosmic rays was also built and tested. The prototype detector consisted of an ion sensitive memory device mounted on a printed circuit board. In space radiation simulations using medical accelerators, the MOS dosimeter was found to have a steady response over the 3 to 17 MeV energy range. A linear response was measured for the flexible MOS dosimeter. Heavy ion experiments were conducted at the Harwell (U.K.) Tandem Generator to test the heavy particle detector. The detector was found to be very sensitive to the high linear energy transfer heavy ions, showing 100 percent efficiency for Cl, Si, and O. Spacebound experiments are being planned in which the dosimeters will be tested on the Mir space station and Biocosmos satellites. CISTI

N93-16830*# David Sarnoff Research Center, Princeton, NJ.

RADIOMETRIC INFRARED FOCAL PLANE ARRAY IMAGING SYSTEM FOR THERMOGRAPHIC APPLICATIONS

B. J. Esposito, N. McCafferty (New Jersey Inst. of Tech., Newark.), R. Brown, J. R. Tower, and W. F. Kosonocky Nov. 1992 39 p

(Contract NAS1-18226; RTOP 307-50-12-06)

(NASA-CR-189701; NAS 1.26:189701) Avail: CASI HC A03/MF A01

This document describes research performed under the Radiometric Infrared Focal Plane Array Imaging System for Thermographic Applications contract. This research investigated the feasibility of using platinum silicide (PtSi) Schottky-barrier infrared focal plane arrays (IR FPAs) for NASA Langley's specific radiometric thermal imaging requirements. The initial goal of this design was to develop a high spatial resolution radiometer with an NETD of 1 percent of the temperature reading over the range of 0 to 250 C. The proposed camera design developed during this study and described in this report provides: (1) high spatial resolution (full-TV resolution); (2) high thermal dynamic range (0 to 250 C); (3) the ability to image rapid, large thermal transients utilizing electronic exposure control (commandable dynamic range of 2,500,000:1 with exposure control latency of 33 ms); (4) high uniformity (0.5 percent nonuniformity after correction); and (5) high thermal resolution (0.1 C at 25 C background and 0.5 C at 250 C background). Author

N93-16935# Laval Univ. (Quebec). Dept. of Physics.

STUDY OF PRECISION ACCELEROMETERS AND FRACTAL AGGREGATES IN MICROGRAVITY Final Report [ETUDE D'ACCELEROMETRES DE PRECISION ET DES AGREGATS FRACTALS EN MICROGRAVITE]

R. J. Slobodrian 30 Mar. 1990 49 p In FRENCH

(Contract DSS-31016-9-6059/01-SW)

(CTN-93-60622) Avail: CASI HC A03/MF A01

A review is presented of the types of accelerometers with potential use in microgravity experimentation. Causes of the main perturbations of the reduced gravity levels found in spacecraft are analyzed and the requirements for a sensor of microgravity perturbations are presented. The designs of some existing accelerometers include those based on pendulums, weighted diaphragms, and interferometers. A new design concept is proposed based on measurement of the position of an iron rod in equilibrium inside a solenoid. In such a system, the asymmetry in the position of the rod inside the solenoid is directly related to the acceleration applied on the rod. A test indicated that such an accelerometer would be feasible and could also be scaled down to a small size suitable for spacebound or aircraft experiments. In related research, fractal aggregates were produced in the laboratory and their form was analyzed by microscopy and by image analysis techniques using specially developed software. Techniques were also developed to measure the fractal dimensions of the samples, which only reached submillimeter dimensions in a terrestrial environment. CISTI

N93-17001*# Auburn Univ., AL. Dept. of Electrical Engineering.

SILICON DEVICE PERFORMANCE MEASUREMENTS TO SUPPORT TEMPERATURE RANGE ENHANCEMENT Semiannual Report, 7 May 1991 - 6 May 1992

James Bromstead, Bennett Weir, R. Wayne Johnson, and Ray Askew 11 May 1992 47 p

(Contract NCC3-175)

(NASA-CR-191780; NAS 1.26:191780) Avail: CASI HC A03/MF A01

Testing of the metal oxide semiconductor (MOS)-controlled thyristor (MCT) has uncovered a failure mechanism at elevated temperature. The failure appears to be due to breakdown of the gate oxide. Further testing is underway to verify the failure mode. Higher current level inverters were built to demonstrate 200 C operation of the N-MOSFET's and insulated-gate-bipolar transistors (IGBT's) and for life testing. One MOSFET failed early in testing. The origin of this failure is being studied. No IGBT's have failed. A prototype 28-to-42 V converter was built and is being tested at room temperature. The control loop is being finalized. Temperature stable, high value (10 micro-F) capacitors appear to be the limiting factor in the design at this time. In this application, the efficiency will be lower for the IGBT version due to the large V sub(cesat) (3.5-4 V) compared to the input voltage of 28 V. The MOSFET version should have higher efficiency; however, the MOSFET does not appear to be as robust at 200 C. Both versions are built for comparison. Author

N93-17041*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SYSTEM FOR DETERMINING THE ANGLE OF IMPACT OF AN OBJECT ON A STRUCTURE Patent Application

William H. Prosser, investor (to NASA) and Michael R. Gorman, inventor (to Navy) 17 Jun. 1992 13 p

(NASA-Case-LAR-14817-1; NAS 1.71:LAR-14817-1;

US-Patent-Appl-SN-903708) Avail: CASI HC A03/MF A01

A method for determining the angle of impact of an object on a thin-walled structure which determines the angle of impact through analysis of the acoustic waves which result when an object impacts a structure is presented. Transducers are placed on and in the surface of the structure which sense the wave caused in the structure by impact. The waves are recorded and saved for analysis. For source motion normal to the surface, the antisymmetric mode has a large amplitude while that of the symmetric mode is very small. As the source angle increases with respect to the surface normal, the symmetric mode amplitude increases while the antisymmetric mode amplitude decreases. Thus, the angle of impact is determined by measuring the relative amplitudes of these two lowest order modes. NASA

N93-17060*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

MULTIWAVELENGTH PYROMETER FOR GRAY AND NON-GRAY SURFACES IN THE PRESENCE OF INTERFERING RADIATION Patent Application

Daniel Ng, inventor (to NASA) 14 Dec. 1992 26 p

(NASA-Case-LEW-15250-1; NAS 1.71:LEW-15250-1;

US-Patent-Appl-SN-991403) Avail: CASI HC A03/MF A01

A method and apparatus for detecting the temperature of gray and non-gray bodies in the presence of interfering radiation are presented. A gray body has a constant emissivity less than 1 and a non-gray body has an emissivity which varies with wavelength. The emissivity and reflectivity of the surface is determined over a range of wavelengths. Spectra are also measured of the extraneous interference radiation source and the surface of the object to be measured in the presence of the extraneous interference radiation source. An auxiliary radiation source is used to determine the reflectivity of the surface and also the emissivity. The measured spectrum of the surfaces in the presence of the extraneous interference radiation source is set equal to the emissivity of the surface multiplied by a Planck function containing a temperature term T plus the surface reflectivity multiplied by the spectrum of the extraneous interference radiation source. The equation is then solved for T to determine the temperature of the surface. NASA

N93-17076*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ELECTRONIC STILL CAMERA Patent Application

S. Douglas Holland, inventor (to NASA) 10 Sep. 1992 103 p

(NASA-Case-MSC-21797-1; NAS 1.71:MSC-21797-1;

US-Patent-Appl-SN-943168) Avail: CASI HC A06/MF A02

A handheld, programmable, digital camera is disclosed that supports a variety of sensors and has program control over the system components to provide versatility. The camera uses a high performance design which produces near film quality images from an electronic system. The optical system of the camera incorporates a conventional camera body that was slightly modified, thus permitting the use of conventional camera accessories, such as telephoto lenses, wide-angle lenses, auto-focusing circuitry, auto-exposure circuitry, flash units, and the like. An image sensor, such as a charge coupled device ('CCD') collects the photons that pass through the camera aperture when the shutter is opened, and produces an analog electrical signal indicative of the image. The analog image signal is read out of the CCD and is processed by preamplifier circuitry, a correlated double sampler, and a sample and hold circuit before it is converted to a digital signal. The analog-to-digital converter has an accuracy of eight bits to insure accuracy during the conversion. Two types of data ports are included for two different data transfer needs. One data port comprises a general purpose industrial standard port and the other a high speed/high performance application specific port. The system uses removable hard disks as its permanent storage media. The hard disk receives the digital image signal from the memory buffer and correlates the image signal with other sensed parameters, such as longitudinal or other information. When the storage capacity of the hard disk has been filled, the disk can be replaced with a new disk. NASA

N93-17077*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ACCELERATION RECORDER AND PLAYBACK MODULE Patent Application

Richard J. Bozeman, Jr., inventor (to NASA) 3 Sep. 1992 22 p

(NASA-Case-MSC-22008-1; NAS 1.71:MSC-22008-1;

US-Patent-Appl-SN-940420) Avail: CASI HC A03/MF A01

The present invention is directed to methods and apparatus relating to an accelerometer electrical signal recorder and playback module. The recorder module may be manufactured in lightweight configuration and includes analog memory components to store data. Signal conditioning circuitry is incorporated into the module so that signals may be connected directly from the accelerometer to the recorder module. A battery pack may be included for powering both the module and the accelerometer. Timing circuitry is included to control the time duration within which data is recorded or played back so as to avoid overloading the analog memory components. Multiple accelerometer signal recordings may be taken simultaneously without analog to digital circuits, multiplexing circuitry or software to compensate for the effects of multiplexing the signals. NASA

N93-17203*# Perry (C. L.), Associates, Huntsville, AL.

REMOTE HYDROGEN SENSING TECHNIQUES Final Report, Apr. - Nov. 1992

Cortes L. Perry Nov. 1992 27 p

(NASA Order H-07982-D)

(NASA-CR-191411; NAS 1.26:191411) Avail: CASI HC A03/MF A01

The objective of this project is to evaluate remote hydrogen sensing methodologies utilizing metal oxide semi-conductor field effect transistors (MOS-FET) and mass spectrometric (MS) technologies and combinations thereof. Author

N93-17404# Groningen Rijksuniv. (Netherlands). Kernfysisch Versneller Inst.

CALIBRATION OF PHOSWICH DETECTORS

H. K. W. Leegte, E. E. Koldenhof, A. L. Boonstra, and H. W. Wilschut 14 Sep. 1991 12 p Submitted for publication Sponsored by Netherlands Organization for Scientific Research

(KVI-891; ETN-92-92544) Avail: CASI HC A03/MF A01

Two different aspects for the calibration of phoswich detector arrays are investigated. It is shown that common gate ADC's can be used: the loss in particle identification due to fluctuations in the gate timing in multi-hit events can be corrected for by a simple procedure using the measured time difference between gate and phoswich signal. The response of phoswich detectors to particles with given Z, A, and E is studied using a magnetic spectrograph. In the absence of mass identification, the energy calibration is limited by the width of the experimental mass distribution for a given element. ESA

N93-17626* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ATMOSPHERIC PRESSURE FLOW REACTOR: GAS PHASE CHEMICAL KINETICS UNDER TROPOSPHERIC CONDITIONS WITHOUT WALL EFFECTS Patent

Steven L. Koontz, inventor (to NASA) and Dennis D. Davis, inventor (to NASA) 12 Jan. 1993 5 p Filed 30 Jul. 1991 Division of US-Patent-Appl-SN-279170, filed 2 Dec. 1988

(NASA-Case-MSC-21384-2; US-Patent-5,179,025;

US-Patent-Appl-SN-737756; US-Patent-Class-436-52;

US-Patent-Class-436-9; US-Patent-Class-436-117; US-Patent-Class-422-83;

US-Patent-Class-422-93; US-Patent-Class-422-110;

Int-Patent-Class-G01N-35/08) Avail: US Patent and Trademark Office

A flow reactor for simulating the interaction in the troposphere is set forth. A first reactant mixed with a carrier gas is delivered from a pump and flows through a duct having louvers therein. The louvers straighten out the flow, reduce turbulence, and provide laminar flow discharge from the duct. A second reactant delivered from a source through a pump is input into the flowing stream, the second reactant being diffused through a plurality of small diffusion tubes to avoid disturbing the laminar flow. The

commingled first and second reactants in the carrier gas are then directed along an elongate duct where the walls are spaced away from the flow of reactants to avoid wall interference, disturbance, or turbulence arising from the walls. A probe connected with a measuring device can be inserted through various sampling ports in the second duct to complete measurements of the first and second reactants and the product of their reaction at selected XYZ locations relative to the flowing system.
Official Gazette of the U.S. Patent and Trademark Office

N93-17777*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A SURVEY AND ANALYSIS OF COMMERCIALLY AVAILABLE HYDROGEN SENSORS
Gary W. Hunter Nov. 1992 23 p
(RTOP 590-21-11)
(NASA-TM-105878; E-7198; NAS 1.26:105878) Avail: CASI HC A03/MF A01

The performance requirements for hydrogen detection in aerospace applications often exceed those of more traditional applications. In order to ascertain the applicability of existing hydrogen sensors to aerospace applications, a survey was conducted of commercially available point-contact hydrogen sensors, and their operation was analyzed. The operation of the majority of commercial hydrogen sensors falls into four main categories: catalytic combustion, electrochemical, semiconducting oxide sensors, and thermal conductivity detectors. The physical mechanism involved in hydrogen detection for each main category is discussed in detail. From an understanding of the detection mechanism, each category of sensor is evaluated for use in a variety of space and propulsion environments. In order to meet the needs of aerospace applications, the development of point-contact hydrogen sensors that are based on concepts beyond those used in commercial sensors is necessary. Author

N93-15767# DNV Ingemansson A.B., Stockholm (Sweden). Structural Dynamics Dept.
DEVELOPMENT OF A FORCE MEASUREMENT DEVICE
Otto Wilmar *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 833-838 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-16329*# Sony Magnetic Products, Inc., Miyagi (Japan).
STABILITY OF METAL PARTICLE AND METAL PARTICULATE MEDIA
Kazuhiro Okamoto *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 6 p(SEE N93-16320 05-82) Sep. 1992 (For primary document see N93-16320 05-82)
Avail: CASI HC A02/MF A03

N93-16330*# Ampex Corp., Redwood City, CA.
AN EMPIRICAL APPROACH TO PREDICTING LONG TERM BEHAVIOR OF METAL PARTICLE BASED RECORDING MEDIA
Allan S. Hadad *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 Sep. 1992 17 p Previously announced as N93-15043 (For primary document see N93-16320 05-82)
Avail: CASI HC A03/MF A03

N93-16331*# Ampex Corp., Redwood City, CA.
THE 19 mm DATA RECORDERS SIMILARITIES AND DIFFERENCES
Steve Atkinson *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 5 p(SEE N93-16320 05-82) Sep. 1992 Previously announced as N93-15042 (For primary document see N93-16320 05-82)
Avail: CASI HC A01/MF A03

N93-16332*# STX Corp., Hampton, VA.
DATA STORAGE AND RETRIEVAL SYSTEM ABSTRACT
Barbara Matheson *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 6 p(SEE N93-16320 05-82) Sep. 1992 (For primary document see N93-16320 05-82)
Avail: CASI HC A02/MF A03

N93-16773*# Christopher Newport Coll., Newport News, VA.
SPACECRAFT OPTICAL DISK RECORDER MEMORY BUFFER CONTROL
Robert F. Hodson *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 124-127 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17338*# Alabama Univ., Huntsville. Dept. of Physics.
THE INNER MAGNETOSPHERIC IMAGER (IMI): INSTRUMENT HERITAGE AND ORBIT VIEWING ANALYSIS
Gordon R. Wilson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N93-15685# Naval Academy, Annapolis, MD.
PICOSECOND OPTICAL MIXING IN PHOTOREFRACTIVE MATERIALS Final Report, 1991 - 1992
C. A. McCartney 8 May 1992 61 p
(AD-A256824; USNA-TSPR-189) Avail: CASI HC A04/MF A01

The interaction of laser light in a photorefractive crystal can form a grating that holds promise as a future means of information storage and optical processing. The goal of the project was to examine grating formation when the laser light consists of pulses of a few picoseconds duration and make a comparison with continuous wave laser light. Toward this end, a device called an optical autocorrelator was constructed to measure the duration of the ultrashort pulses, as they are too brief to be measured by conventional electronic means. Two measurable consequences of the photorefractive effect were examined: beam fanning and self-pumped phase conjugation. Significant differences between pulsed and continuous wave input were noted, and insight into self pumped phase conjugation was gained. The results indicate the response of photorefractive crystals to ultrashort laser pulses remains an attractive item of study. GRA

N93-15696# California Univ., Berkeley. Lawrence Berkeley Lab.
SENSITIVITY STUDIES OF A STANDING-WAVE FREE-ELECTRON LASER
G. Rangarajan and A. Sessler Jun. 1992 27 p Presented at the Advanced Accelerator Concepts Workshop, Port Jefferson, NY, 14-20 Jun. 1992
(Contract DE-AC03-76SF-00098)
(DE93-000575; LBL-32463; ESG-197; CONF-9206193-14) Avail: CASI HC A03/MF A01

A standing-wave free-electron laser (SWFEL) has been proposed for use in a two-beam accelerator (TBA). We modify the previous one-dimensional discrete cavity model of the SWFEL by introducing drifts between cavities. We also vary the input beam energy as a function of the bunch number. In this new model, we obtain a stable equilibrium solution for a well-bunched beam (even after including all nonlinear terms). We obtain analytic expressions characterizing this equilibrium in the limit of small cavity lengths. We study the dependence of fluctuations in signal phase along the device as a function of detuning, input beam energy, beam length, current errors, and initial signal field amplitude. We are able to find an optimized set of parameters for which the output energy changes by less than 3 pct. across the cavities for a 1 pct. detuning. The maximum change in signal phase is less than 0.12 radians. DOE

N93-15822*# Lightwave Electronics Corp., Mountain View, CA.
DEVELOPMENT OF A SHORT PULSE HIGH POWER INFRARED LASER Final Report, May 1988 - Nov. 1990
D. C. Gerstenberger and R. W. Wallace Nov. 1990 29 p Original contains color illustrations

(Contract NAS5-30305)
(NASA-TM-108146; NAS 1.15:108146) Avail: CASI HC A03/MF A01; 1 functional color page

A compact, all solid state Q-switched Nd:YAG laser for laser altimetry was developed during this SBIR Phase 2 Program. The laser provided pulse energies up to 4.5 mJ with 7 nanosecond duration at an optical to optical efficiency of 11 percent. This corresponds to a peak power of 643 kW. The laser employed two dimensional arrays of diode laser bars to side pump thin rectangular Nd:YAG gain elements and a lithium niobate electro-optic Q-switch. This report summarizes the experiments to optimize the performance of the laser and the details of the optical, mechanical, and electrical design of a prototype delivered to NASA. Author

N93-15832# Brookhaven National Lab., Upton, NY.
HIGH POWER PICOSECOND CO2 LASER SYSTEM FOR ATF ELECTRON ACCELERATOR PROJECT
I. Pogorelsky (STI Optronics, Bellevue, WA.) 1992 12 p Presented at the Advanced Accelerator Concepts Workshop, Port Jefferson, NY, 14-20 Jun. 1992
(Contracts DE-AC02-76CH-00016; DE-AC06-83ER-40128)
(DE92-040497; BNL-47827; CONF-9206193-10) Avail: CASI HC A03/MF A01

A picosecond high power CO2 laser system is under the operation at the BNL Accelerator Test Facility. The present paper describes its components and the research efforts to meet the requirements for novel laser acceleration techniques to be tested at the ATF. DOE

N93-15860# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
COMMUNICATIONS: FIBER-COUPLED EXTERNAL-CAVITY SEMICONDUCTOR HIGH-POWER LASER Final Report, 1 Jan. 1989 - 31 Aug. 1992
Robert H. Rediker 31 Aug. 1992 91 p
(Contract N00014-89-J-1163)
(AD-A257386) Avail: CASI HC A05/MF A01

The successful operation is described of the 'Fiber-Coupled External-Cavity Semiconductor high-Power Laser.' Also included is experiment, theory and discussion on the physics of the operation of an external cavity in which a multiplicity of gain elements (semiconductor diode lasers with one facet antireflection (AR) coated) are coherently coupled. Variations of such external cavity schemes are being attempted elsewhere. The desirability of fiber coupling will now be introduced. While diode lasers have many advantages over other types of lasers, at present their output power is limited. At higher powers, large-area single-stripe devices and monolithic arrays are limited by the heat dissipation density. Therefore, to operate these devices at high powers requires sophisticated cooling systems. An alternative technique to achieve high-power operation is to spatially separate sub-groups of lasers and coherently combine their output. GRA

N93-15864# Northeast Semiconductor, Inc., Ithaca, NY.
INNOVATIVE TECHNIQUES FOR THE PRODUCTION OF LOW COST 2D LASER DIODE ARRAYS Monthly Report No. 8, 1-30 Sep. 1992
30 Sep. 1992 9 p
(Contract N00014-91-C-0222)
(AD-A257419) Avail: CASI HC A02/MF A01

The primary objective is to develop a low cost, high yielding methodology for processing, packaging and characterization of MBE grown two dimensional high power laser diode arrays. Projected increases in overall yield of AlGaAs diode lasers would reduce manufacturing cost from the current $10 to $20 per peak watt to below $3 per peak watt. Emphasis is placed on innovative packaging techniques that will use recent advances in diamond heat sinking technology. GRA

N93-15887# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.
LASER GUIDE STARS: BRIDGE OF GROUND-BASED LASERS ENTERING SPACE
Sun Jingwen 23 Sep. 1992 15 p Transl. into ENGLISH from unidentified Chinese language document, p 281-284
(AD-A256649; FASTC-ID(RS)T-0614-92) Avail: CASI HC A03/MF A01

The principle and importance of adaptive imaging of laser guide stars in astronomy and laser astronomy are presented along with a discussion of laser parameters required by laser guide stars. GRA

N93-15939# Los Alamos National Lab., NM.
THERMAL DISTORTION LIMITS ON THE PERFORMANCE OF XUV FREE-ELECTRON LASERS CONFIGURED WITH A MULTIFACET-MIRROR RING RESONATOR
J. C. Goldstein and B. D. McVey 1992 13 p Presented at the SPIE International Symposium on Optical Applied Science and Engineering, San Diego, CA, 19-24 Jul. 1992
(Contract W-7405-eng-36)
(DE92-040387; LA-UR-92-2537; CONF-920792-29) Avail: CASI HC A03/MF A01

XUV (10 mn less than or = gamma less than or = 100 nm) free-electron lasers (FELS) are potential light sources for materials research applications (to complement future synchrotron light sources) and soft x-ray projection lithography applications for the manufacture of electronic microcircuits. Requirements for compact physical dimensions for these devices, together with relatively low reflectivity mirrors and small optical beam sizes at these wavelengths, make thermal loading of the mirrors of XUV FEL oscillators a potentially serious problem. In this paper, we consider the effects of thermal distortion of the on the performance of an XUV FEL designed specifically as a 60 nm light source for lithographic applications. We formulate a mathematical model of the relevant physical processes, and solve that model with the aid of a 3-D FEL simulation code. The numerical solutions demonstrate the existence of an unusual optical mode of the FEL oscillator in which the steady-state resonator power decreases linearly as the thermal distortion coefficient of the mirrors increases. The stabilizing effect of a scraper mirror as a mode control aperture is discussed. Limits on the magnitude of the mirror thermal distortion coefficient, for which near ideal FEL performance is retained, are discussed. DOE

N93-15948# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
TRANSIENT X RAY LASER SCHEMES AT 1 MILLIMICRON AND AT 2 MILLIMICRON
P. Hagelstein, J. Goodberlet, and S. Basu 1991 7 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract DE-FG02-89ER-14012)
(DE92-040670; CONF-9107115-80) Avail: CASI HC A02/MF A01

The development of a pump laser for x-ray lasers which operates at wavelengths longer than 1 micron would permit the attainment of higher electron temperatures for a given pump intensity. Such a system would be of interest for electron collisional schemes at low Z, and would have the potential to improve the overall system efficiency. An initial design for an optical parametric oscillator which would down-convert 1 micron of radiation to 2 microns is presented. DOE

N93-16025# Brookhaven National Lab., Upton, NY.
BRIEFING PAPER FOR THE PROPOSED ULTRAVIOLET FREE-ELECTRON LASER (UV-FEL) FACILITY AT BROOKHAVEN NATIONAL LABORATORY
E. D. Johnson, comp. 15 Jul. 1992 23 p
(Contract DE-AC02-76CH-00016)
(DE92-040568; BNL-47802) Avail: CASI HC A03/MF A01

The proposed Brookhaven National Laboratory ultraviolet free-electron laser (UV-FEL) user facility will provide picosecond and sub-picosecond pulses of coherent ultraviolet radiation for wavelengths from 300 to 75 nm. Pulse width will be variable from about 7 ps to approx. 200 fs, with repetition rates as high as 10(exp 4) Hz, single pulse energies greater than 1 NJ and hence peak pulse power greater than 200 MW and average beam power greater than 10 W. The facility will be capable of 'pump-probe' experiments utilizing the FEL radiation with: (1) synchronized auxiliary lasers; (2) a second, independently tunable FEL beam; or (3) broad-spectrum, high-intensity x-rays from an insertion device in the x-ray ring of the adjacent National Synchrotron Light Source. The UV-FEL consists of a high repetition rate recirculating superconducting linear accelerator which feeds pulses of electrons to two magnetic wigglers. Within these two devices, photons from tunable 'conventional' lasers are frequency multiplied and amplified. By synchronously tuning the seed laser and modulating the energy of the

electron beam, tuning of as much as 60 percent in wavelength is possible between alternating pulses supplied to different experimental stations, with Fourier transform limited resolution. Thus, up to four independent experiments may operate at one time, each with independent control of the wavelength and pulse duration. A total of eight experimental stations are planned, with two currently assigned to general users, two each for solid state and chemical physics, and one each for atomic physics and biology. This document provides a few representative examples of experiments in these fields, as well as an introduction to the facility, its limitations, and its potential for future growth. DOE

N93-16026# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.
ALIGNMENT FOCUSING SYSTEM FOR HIGH-POWER LASER BEAM
Guo Zhenhua and Xia Zhizhong 8 Oct. 1992 14 p Transl. into ENGLISH from unidentified Chinese language document p 15-19
(AD-A256907; FASTC-ID(RS)T-0618-92) Avail: CASI HC A03/MF A01

To produce the high-power density of 10,000 watt class CO2 laser beams for research on the interaction between high-power lasers and matter as well as far-field experiments, a high-power laser alignment focusing system was developed based on infrared materials available in China. The system has been operated to improve the properties of high-power lasers. These experiments are open to visiting scholars from elsewhere. GRA

N93-16053# Science Research Lab., Inc., Somerville, MA.
FERRITE RESEARCH AIMED AT IMPROVING INDUCTION LINAC DRIVEN FEL PERFORMANCE, PHASE 2 Final Report, 15 Sep. 1990 - 30 Sep. 1992
Daniel Birx 15 Oct. 1992 299 p
(Contract N00014-90-C-0165)
(AD-A256779; SRL-13-F-1992) Avail: CASI HC A13/MF A03

The primary goal of this program was to improve the performance of induction accelerators with particular regards to their being used to drive FELs. The strategy for achieving this end was to first optimize the nonlinear magnetic material used in induction accelerator construction and secondly to optimize the design in terms of cost, size and efficiency. We began this research effort with an in depth study into the properties of various nonlinear magnetic materials (e.g. various ferrite composites, Metglas (an amorphous tape composed of steel and glass), and more conventional magnetic materials such as 50/50 Ni-Fe tapes). An all-solid-state, nonlinear magnetic pulse compressor, denoted SNOMAD-V was constructed for this purpose. As more information was obtained the design was optimized with the aim of producing as short an output pulse as possible. This unique pulse generator was finally proven capable of producing gigawatt pulses as short as 2 nanoseconds in duration with risetimes less than 150 picoseconds at repetition rates as high as 10 kHz. GRA

N93-16098# Texas Univ., Houston. Cancer Center.
DIAGNOSTIC AND THERAPEUTIC APPLICATIONS OF DIODE LASERS AND SOLID STATE LASERS IN MEDICINE
S. L. Jacques, A. J. Welch (Texas Univ., Austin.), M. Motamedi (Texas Univ., Galveston.), and S. Rastegar (Texas A&M Univ., College Station.) May 1992 19 p
(Contract DE-FG05-91ER-61226)
(DE92-040338; DOE/ER-61226/1) Avail: CASI HC A03/MF A01

The Texas Medical Center in Houston and the nearby UT Medical Branch at Galveston together constitute a major center of medical research activities. Laser applications in medicine are under development with the engineering assistance of the colloborating engineering centers at Rice University, UT-Austin, and Texas A&M Univ. In addition, this collective is collaborating with the Naval Research Laboratory, where new developments in laser design are underway, in order to transfer promising new laser technology rapidly into the medical environment. DOE

N93-16104# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
WHISPERING-GALLERY MIRRORS FOR SHORT-WAVELENGTH LASER CAVITIES: SHAPES AND TOLERANCES
J. P. Braud 1991 6 p Presented at the Society of Photo-Optical Instrumentation Engineers Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract DE-FG02-89ER-14012)
(DE92-040667; CONF-9107115-78) Avail: CASI HC A02/MF A01

The whispering-gallery mirrors desired for use in short-wavelength laser cavities are seen to be highly aspheric and very different from the shapes encountered in conventional optics. Fabrication tolerances are established by examining the effects of various surface imperfections. The mirrors are found to be relatively insensitive to figures errors. The requirements on surface finish are shown to be fairly strict, though less severe than with normal-incidence optics. DOE

N93-16105# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
POLARIZING OPTICS FOR THE SOFT X RAY REGIME: WHISPERING-GALLERY MIRRORS AND MULTILAYER BEAMSPLITTERS
J. P. Braud 1991 5 p Presented at the Society of Photo-Optical Instrumentation Engineers Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract DE-FG02-89ER-14012)
(DE92-040668; CONF-9107115-81) Avail: CASI HC A01/MF A01

Two short-wavelength optical components are described. The first, the whispering-gallery mirror, uses many glancing-incidence reflections to deflect a beam through a large net angle. Because the Fresnel coefficient for each reflection depends upon the state of polarization, the whispering-gallery mirror can act both as a polarizer and as a birefringent element. The second, the multilayer polarizing beamsplitter, is a Brewster-angle reflector thin enough to allow partial transmission of the incident beam. Its behavior can be surprising; in some cases the same polarization mode is preferred on both reflection and transmission. DOE

N93-16106# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
DEVELOPMENT OF THE MIT TABLETOP SOFT X RAY LASER
P. L. Hagelstein 1991 21 p Presented at the Society of Photo-Optical Instrumentation Engineers Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract DE-FG02-89ER-14012)
(DE92-040671; CONF-9107115-79) Avail: CASI HC A03/MF A01

We have been developing a small-scale EUV laser facility at MIT with which we hope to observe gain in nickel-like molybdenum at 191 A. The physics involved in the formation of laser gain is examined through the use of simple models, and optimum operating temperatures and electron densities are determined. The upper state population is determined primarily through a balance between direct collisional excitation to and from the upper laser state; the lower state population follows primarily from a balance between indirect excitation and radiative decay. Models describing these balances are used to estimate optimum conditions and the resulting population inversions. DOE

N93-16183# Los Alamos National Lab., NM.
DESIGN OF A COMPACT APPLICATION-ORIENTED FREE-ELECTRON LASER
K. C. D. Chan, K. Meier, D. Nguyen, R. Sheffield, T. S. Wang, R. W. Warren, W. Wilson, and L. M. Young 1992 16 p Presented at the 16th International LINAC Conference, Ottawa, Ontario, 23-28 Aug. 1992
(Contract W-7405-eng-36)
(DE92-040391; LA-UR-92-2515; CONF-9208109-16) Avail: CASI HC A03/MF A01

The goal of the Advanced Free-Electron Laser Project at the Los Alamos National Laboratory is to demonstrate that a free-electron laser (FEL) suitable for industrial, medical, and research applications can be built. This FEL system should be efficient, compact, robust, and user-friendly. To achieve this goal, we have incorporated advanced components presently available. Electrons produced by a photoelectron source are accelerated to 20 MeV by a high-brightness accelerator. They are transported by an emittance-preserving beamline with permanent-magnet quadrupoles and dipoles. The electron beam has excellent instantaneous beam quality better than: 2.5 (pi) mm mrad in transverse emittance and 0.3 percent in energy spread at a Peak current up to 310 A. It is used to excite a FEL oscillator with a pulsed-current microwiggler. Including operation at higher harmonics, the laser wavelength extends from 3.7 to 0.4 microns. DOE

N93-16193# Utah Univ., Salt Lake City.
PULSED LASER KINETIC STUDIES OF LIQUIDS UNDER HIGH PRESSURE

E. M. Eyring 22 Sep. 1992 7 p
(Contract DE-FG02-84ER-13227)
(DE93-000884; DOE/ER-13227/T4) Avail: CASI HC A02/MF A01

A laser flash photolysis kinetic study of 2,2'-bipyridine bidentate chelating ligands with one claw in the first coordination sphere of a molybdenum carbonyl complex has been completed at pressures up to 150 MPa. The reaction mechanism for thermal ring closure is found from activation volumes to change from associative interchange to dissociative interchange as substituents on the 2,2'-bipyridine ligands become bulkier. In a similar study of more rigid, substituted phenanthroline bidentate ligands it was found that substituent bulkiness had little effect on the thermal ring closure mechanism. Stability constants for lithium ion complexes with crown ethers in a room temperature molten salt, fluorescence quantum yields for cresyl violet and several other dyes in solution, and the oxidation of alcohols by OsO4 have also been studied. DOE

N93-16204# Argonne National Lab., IL.
TIME-RESOLVED ELECTRON-BEAM CHARACTERIZATIONS WITH OPTICAL TRANSITION RADIATION
A. H. Lumpkin and M. D. Wilke (Los Alamos National Lab., NM.) 1992 21 p Presented at the 14th International Free Electron Laser Conference, Kobe, Japan, 23-28 Aug. 1992
(Contracts W-31-109-eng-38; W-7405-eng-36)
(DE92-041122; ANL/CP-76108; CONF-9208142-3) Avail: CASI HC A03/MF A01

Time-resolved characterizations of electron beams using optical transition radiation (OTR) as a prompt conversion mechanism have recently been extended on the Los Alamos Free-Electron Laser (FEL) facility 40-MeV linac. Two key timescales for RF-linac driven FEL's are the micropulse (10 ps) and the macropulse (5 microsec. to 1 ms). In the past we have used gated, intensified cameras to select a single or few micropulses (25 to 400 ns gate width) out of the pulse train to evaluate submacropulse effects. Recently, we have obtained some of the first measurements of micropulse bunch length (7 to 10 ps) and submacropulse spatial position and profile using OTR and a Hamamatsu streak camera. Additionally, micropulse elongation effects and head-to-tail transverse kicks are reported as a function of charge. DOE

N93-16432# Connecticut Univ., Storrs. Dept. of Physics.
RADIATIONLESS TRANSITIONS AND EXCITED-STATE ABSORPTION IN TUNABLE LASER MATERIALS Final Report, 1 Jun. 1989 - 31 Jul. 1992
Ralph H. Bartram 28 Sep. 1992 50 p
(Contract DAAL03-89-K-0059)
(AD-A256948; ARO-26442.8-PH) Avail: CASI HC A03/MF A01

A coordinated experimental and theoretical investigation of fluorescence quenching and excited-state absorption was conducted on the chromium-doped halide elpasolites K2NaGaF6, K2NaScF6 and Cs2NaYCl6, and on the laser-active Tl sup 0 (1) color center in KCl. Luminescence lifetime measurements on Cs2NaYCl6:Cr(3+) revealed a linear pressure dependence of the activation energy for thermal fluorescence quenching which was accurately predicted by a semi-empirical theoretical model incorporating quadratic coupling to an asymmetric mode. An ab-initio theoretical model, based on embedded-cluster and lattice-statics and dynamics calculations, accounted very well for optical and vibrational properties of these materials, but still needs refinement for reliable prediction of thermal quenching behavior. Two-photon excitation spectroscopy helped to explain broadband excited state absorption. GRA

N93-16446# Colorado State Univ., Fort Collins.
CAPILLARY DISCHARGE EXTREME ULTRAVIOLET LASERS
J. J. Rocca Aug. 1992 28 p
(Contract DE-FG02-91ER-12110)
(DE92-040853; DOE/ER-12110/2) Avail: CASI HC A03/MF A01

The project objective is to explore the generation of soft X ray laser radiation in a plasma column created by a fast capillary discharge. The proposed capillary lasing scheme offers the potential for compact, simple and efficient soft X ray laser sources. For this purpose a compact, fast pulse generator which produces 100 kA current pulses with a risetime of 11 ns was constructed. Initial experiments were conducted in evacuated capillaries, in which the plasma is produced by ablation of the capillary walls. The soft X ray emission from discharges in polyethylene capillary channels was studied for the possibility of amplification in the 3-2 transition of C VI, at lambda = 18.2 nm. Time-resolved spectra in which this transition appears anomalously intense with respect to the 4-2 transition of the same ion were obtained. To date, however, this phenomenoa could not be confirmed as gain, as the intensity of the 18.2 nm line has not been observed to increase exponentially as a function of the capillary length. Encouraging results were obtained by fast pulse discharge excitation of capillaries filled with preionized gas. High temperature (Te greater than 150 eV), small diameter (approx. 200 micron) plasma were efficiently generated. Fast current pulse excitation of a selected low mass density of uniformly preionized material. Mag the capillary was observed to detach rapidly the plasma from the capillary walls, and form a plasma channel of a diameter much smaller and significantly hotter than those produced by a similar current pulse in evacuated capillaries of the same size. Discharges in argon-filled capillaries at currents between 20 and 60 kA produced plasmas with ArX-Ar(sub XIV) line emission, and with spectra that are similar to those of plasmas generated by greater than 1 MA current implosions in large pulsed power machines. The characteristic of these plasmas approach those necessary for soft X ray amplification in low Z elements. DOE

N93-16469 Department of the Navy, Washington, DC.
MULTIPLE ELEMENT RING LASER Patent
Richard Scheps, inventor (to Navy) 9 Jun. 1992 7 p Filed 28 Sep. 1990
(AD-D015471; US-Patent-5,121,402; US-Patent-Appl-SN-593417; US-Patent-Class-372-70) Avail: US Patent and Trademark Office

A multiple gain-element ring laser has the capability of being scaled to higher CW or pulsed output powers. Optical pumping is accommodated in a plurality of optically interconnected single gain-element building blocks, each made up of a mirror associated with a gain element, such as Nd:YAG or Nd:YVO4, pumped by the optical pumping light from, for example, separate diodes in a focus (waist) at or near an exterior face of each gain element. A resonator mode is established in each gain element which also comes to a focus (waist) at or near the same exterior face in each gain element of the multi-element ring laser. Concatenating the gain elements and the associated mirrors into a desired multiple gain-element ring laser configuration provides for good overlap between the pump light from the several diodes and the resonator mode to achieve desired power levels at an improved efficiency, inclusion of a Q-switch and/or mode locker provides Q-switched and/or mode locked operation. Inclusion of a nonlinear crystal allows a high energy efficiency conversion to a different frequency. All gain elements, mirrors and intracavity elements are provided with appropriate optical coatings. Second harmonic generation is a selectable option that is also single frequency and amplitude stable. A further feature is that wavelength tuning is provided for by, for example, mounting one of the ring elements on a piezoelectric driven mount. GRA

N93-16529# California Univ., Berkeley. Lawrence Berkeley Lab.
COMMON ANALYSIS OF THE RELATIVISTIC KLYSTRON AND THE STANDING-WAVE FREE-ELECTRON LASER TWO-BEAM ACCELERATOR
Jonathan S. Wurtele (Massachusetts Inst. of Tech., Cambridge.), David H. Whittum (National Lab. for High Energy Physics, Tsukuba, Japan), and Andrew M. Sessler Jul. 1992 3 p Presented at the International Conference on High Energy Accelerators, Hamburg, Germany, 20-24 Jul. 1992
(Contracts DE-AC03-76SF-00098; DE-FG02-91ER-40648)
(DE92-041205; LBL-32580; ESG-208; CONF-920706-37) Avail: CASI HC A01/MF A01

This paper summarizes a new formalism which makes the analysis and understanding of both the relativistic klystron (RK) and the standing-wave free-electron laser (SWFEL) two-beam accelerator (TBA) available to a wide audience of accelerator physicists. A 'coupling impedance' for both the RK and SWFEL is introduced, which can include realistic cavity features, such as beam and vacuum ports, in a simple manner. The RK and SWFEL macroparticle equations, which govern the energy and phase evolution of successive bunches in the beam, are of identical form, differing only by multiplicative factors. The analysis allows, for the first time, a relative comparison of the RF and SWFEL TBA's. DOE

N93-16610# Department of the Navy, Washington, DC.
RESONANTLY PUMPED, ERBIUM-DOPED, GSGG, 2.8 MICRON, SOLID STATE LASER WITH ENERGY RECYCLING AND HIGH SLOPE EFFICIENCY Patent Application
Leon Esterowitz and Robert Stoneman, inventors (to Navy) 14 May 1992 39 p
(AD-D015517; US-Patent-Appl-SN-883336; Navy-Case-74158) Avail: CASI HC A03/MF A01

A laser system and a method for producing a laser emission at a wavelength of approximately 2.8 microns are presented. The system and method have a quantum efficiency of at least unity and a slope efficiency of about 36 percent. The laser system is comprised of the following: a laser cavity defined by first and second reflective elements with one of the reflective elements operating as an output coupler; a crystal disposed in the laser cavity and having a GSGG host material doped with a preselected percent concentration of erbium, the GSGG host material and preselected percent concentration of erbium being selected so as to provide a quantum efficiency of at least unity by the (sup 4)I(sub 13/2) + (sup 4)I(sub 13/2) yields (sup 4)I(sub9/2) + (sup 4)I(sub 15/2) upconversion process and a slope efficiency of about 36 percent when the crystal is resonantly pumped; and a resonant pump laser for directly pumping the (sup 4)I(sub 11/2) upper laser state of the erbium with a pump beam to cause the crystal to produce a laser emission corresponding to the (sup 4)I(sub 11/2) yields (sup 4)I(sub 13/2) laser transition having a wavelength of substantially 2.8 microns. Author (GRA)

N93-16664*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
APPLICATION OF A LASER SCANNER TO THREE DIMENSIONAL VISUAL SENSING TASKS
Arthur M. Ryan May 1992 136 p
(Grant NAGw-1333)
(NASA-CR-191834; NAS 1.26:191834; CIRSSE-112) Avail: CASI HC A07/MF A02

The issues are described which are associated with using a laser scanner for visual sensing and the methods developed by the author to address them. A laser scanner is a device that controls the direction of a laser beam by deflecting it through a pair of orthogonal mirrors, the orientations of which are specified by a computer. If a calibrated laser scanner is combined with a calibrated camera, it is possible to perform three dimensional sensing by directing the laser at objects within the field of view of the camera. There are several issues associated with using a laser scanner for three dimensional visual sensing that must be addressed in order to use the laser scanner effectively. First, methods are needed to calibrate the laser scanner and estimate three dimensional points. Second, methods to estimate three dimensional points using a calibrated camera and laser scanner are required. Third, methods are required for locating the laser spot in a cluttered image. Fourth, mathematical models that predict the laser scanner's performance and provide structure for three dimensional data points are necessary. Several methods were developed to address each of these and has evaluated them to determine how and when they should be applied. The theoretical development, implementation, and results when used in a dual arm eighteen degree of freedom robotic system for space assembly is described. Author

N93-16689*# General Optronics Corp., Edison, NJ.
THE 1.083 MICRON TUNABLE CW SEMICONDUCTOR LASER Final Report
C. S. Wang, Jan-Shin Chen, Ken-Gen Lu, and Keng Ouyang 28 Jun. 1991 43 p
(Contract NAS7-1034; SBIR-08.10-9000)
(NASA-CR-191338; NAS 1.26:191338) Avail: CASI HC A03/MF A01

A tunable CW laser is desired to produce light equivalent to the helium spectral line at 1.08 microns. This laser will serve as an optical pumping source for He-3 and He-4 atoms used in space magnetometers. This light source can be fabricated either as a semiconductor laser diode or a pumped solid state laser. Continuous output power of greater than 10 mW is desired. Semiconductor lasers can be thermally tuned, but must be capable of locking onto the helium resonance lines. Solid state lasers must have efficient pumping sources suitable for space configuration. Additional requirements are as follows: space magnetometer applications will include low mass (less than 0.5 kg), low power consumption (less than 0.75 W), and high stability/reliability for long missions (5-10 years). Author

N93-16706*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
DEVELOPMENT OF TECHNIQUES REQUIRED FOR THE APPLICATION OF A LASER TO THREE DIMENSIONAL VISUAL SENSING
Arthur M. Ryan and Lester A. Gerhardt Aug. 1991 53 p
(Grant NAGw-1333)
(NASA-CR-191855; NAS 1.26:191855; CIRSSE-101) Avail: CASI HC A04/MF A01

The ongoing vision research at the Center for Intelligent Robotic Systems for Space Exploration (CIRSSE) is directed toward identifying and addressing the relevant issues involved in applying visual sensing to space assembly tasks. A considerable amount of effort has been devoted to passive sensing techniques such as using multiple cameras to identify objects in a scene. To compliment the capabilities of the passive visual system in the CIRSSE robotics testbed, research is being conducted in active sensing techniques. This report is description of the research associated with the testbed's laser scanner and its application as an active sensing device. The report is comprised of five major topics. First is a brief description of the CIRSSE visual system and a summary of the active sensing research that has been conducted up to this point. Second, some of the methods currently used to calibrate CIRSSE's laser scanner are described as well as an appraisal of the effectiveness of these methods. Third, is a discussion of how the laser scanner can be employed in concert with a camera to provide a three dimensional point estimation capability. Fourth, there is a description of methods that can be used to detect the presence of the laser beam in a cluttered camera image. Finally, there is a summary of the current state of this research and a description of research planned for the future. Author

N93-16848# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra and Geometry.
AN FFT-BASED METHOD FOR ATTENUATION CORRECTION IN FLUORESCENCE CONFOCAL MICROSCOPY
J. B. T. M. Roerdink and M. Bakker Dec. 1991 20 p
(CWI-AM-R9114; ETN-92-92475) Copyright Avail: CASI HC A03/MF A01

A problem in three dimensional imaging by a confocal scanning laser microscope in the (epi)fluorescence mode is the darkening of the deeper layers due to absorption and scattering of both the excitation and the fluorescence light. A new method to correct for these effects is proposed. The approach, valid for weak attenuation, consists of multiplying the measured fluorescence intensity by a correction factor involving a convolution integral of the measured signal, which can be computed efficiently for the Fast Fourier Transform (FFT). Analytical and numerical estimates as to the degree of attenuation under which the method is valid are given and the method is tested on various test images. The method is compared with a recent iterative method with regard to numerical accuracy and computational efficiency. ESA

N93-16923# Columbia Univ., New York, NY.
INVERSE FREE ELECTRON LASER BEAT-WAVE ACCELERATOR RESEARCH Annual Progress Report
T. C. Marshall and A. Bhattacharjee Aug. 1992 7 p
(Contract DE-FG02-91ER-40669)
(DE93-002770; DOE/ER-40669/2) Avail: CASI HC A02/MF A01

In the past twelve-month period, we have completed our experimental study of the inverse-FEL autoaccelerator. The IFEL accelerates electrons by stimulated absorption of a laser pulse passing along an electron beam in an undulator; the autoaccelerator is a configuration we have developed at Columbia to test the principle of resonant absorption and acceleration. This report discusses the progress of this research. DOE

N93-16970# Brookhaven National Lab., Upton, NY.
DESIGN OF DISPERSION SECTION FOR THE ATF HARMONIC GENERATION FEL
X. Zhang, I. Ben-Zvi, G. Ingold, S. Krinsky, and L. H. Yu 1992 10 p
(Contract DE-AC02-76CH-00016)
(DE93-001655; BNL-47968) Avail: CASI HC A02/MF A01

We present an analysis of the dispersion magnet for the high gain harmonic generation experiment to be carried out at the Accelerator Test Facility at BNL. The purpose of the dispersion magnet is to convert energy modulation of the electron beam into spatial bunching. For the dispersion magnet, we discuss the physical requirements, analyze the magnetic design, determine the focusing properties, and consider the effect on the FEL gain of departures from idea behavior on the FEL gain. DOE

N93-17009# Brookhaven National Lab., Upton, NY.
FREE-ELECTRON LASER RESEARCH AND DEVELOPMENT AT BNL
I. Ben-Zvi 1992 8 p Presented at the Third NSF-QEWB Workshop on Plasma Science, New York, NY, 4 Jun. 1992
(Contract DE-AC02-76CH-00016)
(DE93-000373; BNL-47888; CONF-9206294-1) Avail: CASI HC A02/MF A01

Free-Electron Lasers (FEL) are considered by many to be the fourth generation synchrotron light sources. The National Synchrotron Light Source (NSLS) at BNL is carrying out an extensive R&D program on short wavelength FEL leading towards a proposal for a VUV FEL User Facility. Research and development towards this goal are carried out at the Accelerator Test Facility (ATF). The ATF is a linac-laser complex capable of producing high brightness electron beams and high power laser pulses synchronized with the electrons. The ATF is the test bed for developing and testing the components needed for a successful UV-FEL. At the some time the ATF is serving an advanced accelerator R&D program such as laser acceleration of electron beams and the interaction of intense laser pulses with high brightness electron beams. DOE

N93-17462# Lawrence Livermore National Lab., CA.
LINE OVERLAP MEASUREMENTS FOR RESONANT PHOTO-PUMPING OF X RAY LASERS
S. R. Elliott, P. Beiersdorfer, and J. Nilsen 25 Aug. 1992 4 p Presented at the 6th International Conference on Physics of Highly Charged Ions, Manhattan, KS, 28 Sep. - 2 Oct. 1992
(Contract W-7405-eng-48)
(DE93-001620; UCRL-JC-111447; CONF-920948-4) Avail: CASI HC A01/MF A01

Measurements taken on the LLNL EBIT to search for the possible photo-pumping of the 3p-3s lasing transitions in Ne-like ions of elements with Z = 30-40 and the 4d-4p lasing transitions in Ni-like ions of elements with Z = 47-73 are reported. A high-resolution crystal spectrometer was used to measure wavelengths of the Ne-like 2p-4d and the Ni-like 3d-5f and 3d-6f laser level feeding transitions relative to candidate pump lines in various H-, He-, and Ni-like ions. To date, the most promising candidate is Ni-like Pt pumping Ne-like Rb at 2512 eV. The line energies differ by 0.4 +/- 0.1 eV or by 160 ppm. DOE

N93-17654# Brookhaven National Lab., Upton, NY.
INVERSE FREE ELECTRON LASER ACCELERATOR
A. Fisher, J. Gallardo, A. VanSteenbergen, and J. Sandweiss (Yale Univ., New Haven, CT.) Sep. 1992 21 p Presented at the Advanced Accelerator Concepts Workshop, Port Jefferson, NY, 14-20 Jun. 1992
(Contract DE-AC02-76CH-00016)
(DE93-001963; BNL-47974; CONF-9206193-17) Avail: CASI HC A03/MF A01

The study of the INVERSE FREE ELECTRON LASER, as a potential mode of electron acceleration, is being pursued at Brookhaven National Laboratory. Recent studies have focussed on the development of a low energy, high gradient, multi stage linear accelerator. The elementary ingredients for the IFEL interaction are the 50 MeV Linac e(-) beam and the 10(exp 11) Watt CO2 laser beam of BNL's Accelerator Test Facility (ATF), Center for Accelerator Physics (CAP) and a wiggler. The latter element is designed as a fast excitation unit making use of alternating stacks of Vanadium Permendur (VaP) ferromagnetic laminations, periodically interspersed with conductive, nonmagnetic laminations, which act as eddy current induced field reflectors. Wiggler parameters and field distribution data will be presented for a prototype wiggler in a constant period and in a approximately 1.5 percent/cm tapered period configuration. The CO2 laser beam will be transported through the IFEL interaction region by means of a low loss, dielectric coated, rectangular waveguide. Short waveguide test sections have been constructed and have been tested using a low power CW CO2 laser. Preliminary results of guide attenuation and mode selectivity will be given, together with a discussion of the optical issues for the IFEL accelerator. The IFEL design is supported by the development and use of 1D and 3D simulation programs. The results of simulation computations, including also wiggler errors, for a single module accelerator and for a multi-module accelerator will be presented. DOE

N93-17703# Naval Aerospace Medical Research Lab., Pensacola, FL.
THE FORWARD MASKING EFFECTS OF LOW-LEVEL LASER GLARE ON TARGET LOCATION PERFORMANCE IN A VISUAL SEARCH TASK
M. D. Reddix, J. A. DAndrea, and P. D. Collyer Jan. 1992 23 p
(NR Proj. M00-96)
(AD-A258022; NAMRL-1371) Avail: CASI HC A03/MF A01

The present study examined the effects of low-intensity laser glue, far below a level that would cause ocular damage or flashblindness, on the visually guided performance of aviators. With a forward-masking paradigm, this study showed that the time at which laser glare is experienced, relative to initial acquisition of visual information, differentially affects the speed and accuracy of target-location performance. Brief exposure (300 ms) to laser glare, terminating with a visual scene's onset, produced significant decrements in target-location performance relative to a no-glare control whereas a 150 and 300-ms delay of display onset (DDO) had very little effect. The intensity of the light entering the eye and producing these effects was far below the Maximum Permissible Exposure (MPE) limit for safe viewing of coherent light produced by an argon laser. In addition, these effects were modulated by the distance of the target from the center of the visual display. This study demonstrated that the presence of laser glare is not sufficient, in and of itself, to diminish target-location performance. The time at which laser glare is experienced is an important factor in determining the probability and extent of visually mediated performance decrements. GRA

N93-15766# Nova Scotia Technical Coll., Halifax. Dept. of Mechanical Engineering.
DEVELOPMENT OF A LASER-BASED MEASUREMENT SYSTEM FOR MODAL TESTING OF LARGE SPACE STRUCTURES
A. K. Mitchell, C. R. Hazell, and Y. Soucy (Canadian Space Agency, Ottawa, Ontario) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 827-831 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-16781*# Norfolk State Univ., VA. Dept. of Chemistry.
DIODE INJECTION - SEEDED, 940 NANOMETER (nm), TITANIUM - SAPPHIRE LASER FOR H2O DIAL (DIFFERENTIAL ABSORPTION LIDAR), MEASUREMENTS
George E. Miller *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 147-152 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

N93-16798*# California Polytechnic State Univ., San Luis Obispo.
IMPROVEMENT IN THE CONTROL ASPECT OF LASER FREQUENCY STABILIZATION FOR SUNLITE PROJECT
Omar Zia *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 200-203 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16910*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LASER POWER TRANSMISSION
Edmund J. Conway *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 70-81 Original contains color illustrations (For primary document see N93-16905 05-91)
Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N93-15954# Argonne National Lab., IL.
US MAGLEV: STATUS AND OPPORTUNITIES
H. T. Coffey 1992 6 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE92-041132; ANL/CP-76181; CONF-920802-10) Avail: CASI HC A02/MF A01

Recognizing the development of maglev systems in Germany and Japan, and the growing congestion, air pollution, and energy consumption resulting from our current transportation system, the United States, in 1990, embarked on a program to evaluate the potential usefulness of these systems in the U.S. In this paper, the utility of maglev systems in alleviating some of these problems, progress in the current program, and opportunities for participation by the superconductivity and cryogenic communities are discussed. DOE

N93-16086# Colorado School of Mines, Golden. Center for Welding and Joining Research.
NOVEL CONCEPTS IN WELD SCIENCE: ROLE OF GRADIENTS AND COMPOSITE STRUCTURE
D. K. Matlock and D. L. Olson 31 Aug. 1992 17 p
(Contract DE-FG02-87ER-45308)
(DE92-040893; DOE/ER-45308/6; MT-CWJR-092-023) Avail: CASI HC A03/MF A01

The effects of compositional and microstructural gradients on weld metal properties were investigated. The effects of compositional gradients were analyzed using thermodynamic and composite models. Brittle and ductile cracking behavior were investigated using both binary alloy single crystals and large grain castings. In both cases, the crack propagated along regions where the compositional gradients were the steepest. High temperature deformation of large wavelength compositionally modulated structures was studied to understand creep behavior in weld metal. At moderate temperatures, the creep behavior of cored materials was found to follow predictions based on the rule of mixtures composite analysis. At higher temperatures with the advent of dynamic mass transport the creep process is influenced by diffusion-promoted vacancy flow and time-dependent compositional gradient. The study found the critical gradient which will promote Kirkendall voids and has reported a creep rate behavior that suggests strong structural dependence, localized stress and vacancy transport influence. Weld metal, based on metal matrix composite, was also demonstrated. DOE

N93-16154# Naval Postgraduate School, Monterey, CA.
A CORRELATION OF WELDING SOLIDIFICATION PARAMETERS TO WELD MACROSTRUCTURE M.S. Thesis
Francis G. Novak 18 Jun. 1992 93 p
(AD-A256702) Avail: CASI HC A05/MF A01

A 3-D finite difference model simulating single pass autogenous welds was used to predict the temperature fields in HY-80 steel arc weldments at various powers and torch velocities. From the predicted temperature field, two important solidification parameters were calculated at the solid-liquid interface: temperature gradients and crystal growth velocities. These were correlated with the macrostructures observed in actual weldments. For purposes of model validation, the predicted and actual fusion zone sizes were in agreement, as were the predicted time temperature curves compared to those measured with thermocouples embedded in the plate. GRA

N93-16178# Texas Univ., Austin.
THE RAILPLUG: DEVELOPMENT OF A NEW IGNITOR FOR INTERNAL COMBUSTION ENGINES
R. D. Matthews, S. P. Nichols, and W. F. Weldon Oct. 1992 7 p
(Contract DE-FG05-91ER-12115)
(DE93-003068; DOE/ER-12115/2) Avail: CASI HC A02/MF A01

The railplug project is essentially divided into three main tasks: (1) Railplug System Development; (2) Application of Railplugs to Engines; and (3) Railplug Durability. Railplug system development is subdivided into two categories: power supply development and ignitor development. In addition to these two categories, there is also a significant amount of work in progress to standardize the evaluation techniques used to measure railplug system performance. These issues are described below. The railplug requires a high voltage spike to breakdown the gap between the rails followed by some sustained voltage to drive the arc down the rails. The power supply chosen is a parallel circuit supply. The parallel circuit utilizes a high voltage (approx. 20 kV) ignition coil in parallel with relatively low voltage (less than 600 V) capacitors to supply the breakdown and follow-on energies to the plug. The capacitors are charged off of line voltage while an automotive battery and opening switch provide the input to the ignition coil. The circuit is simple, inexpensive, and reliable, but has the drawback of requiring a high voltage diode to isolate the low voltage capacitors from the high voltage impulse. This is not really a single element, but rather consists of many diodes serially connected to achieve a high stand-off voltage. It has a limited average current rating, which means that high rep rates (greater than or = 30 Hz) are currently not attainable. The diode also consumes significant amounts of energy. This power supply has consistently discharged railplugs at pressures up to 500 psig. DOE

N93-16238# Massachusetts Inst. of Tech., Cambridge.
CRYOTRIBOLOGY: DEVELOPMENT OF CRYOTRIBOLOGICAL THEORIES AND APPLICATION TO CRYOGENIC DEVICES
Y. Iwasa, P. Michael, and E. Rabinowicz 15 Sep. 1992 232 p
(Contract DE-FG02-85ER-13335)
(DE93-000404; DOE/ER-13335/1) Avail: CASI HC A11/MF A03

High-performance superconducting solenoids are susceptible to premature quenches, or superconducting to normal state transitions, due to abrupt conductor movements within the winding. Abrupt motions involving 5 to approx. 10 micron conductor displacements dissipate sufficient energy to trigger a quench. Sliding and mechanical behaviors of materials at cryogenic temperatures have been experimentally examined. After accounting for changes in the sliding materials' low temperature strength properties, it was found that the adhesion theory of friction and wear remains applicable at cryogenic temperatures. The adhesion friction theory suggests two methods for controlling unsteady sliding motions. The first involves the selection of sliding materials whose friction coefficients increase with increasing sliding speed. A number of material pairs were examined for positive friction-velocity characteristics. This materials-based approach to frictional stabilization does not seem a viable option at 4.2 K. The second alternative is to preprogram the force conditions within high risk regions of the winding to regulate the occurrence of unsteady sliding motions. Structural models are proposed to account for unsteady conductor motions on a variety of dimensional scales. The models are used to design a small superconducting solenoid. Performance of this solenoid suggests that force-based motion control is a potentially viable design approach for achieving successful dry-wound magnets. DOE

N93-16406# Washington State Energy Office, Olympia.
A LOW EMISSION VEHICLE PROCUREMENT APPROACH FOR WASHINGTON STATE
G. A. McCoy, J. K. Lyons, and G. Ware Jun. 1992 75 p Prepared for Washington State Dept. of Ecology, Olympia
(DE92-040561; WSEO-92-071) Avail: CASI HC A04/MF A01

The Clean Air Washington Act of 1991 directs the Department of Ecology to establish a clean-fuel vehicle standard. The Department of General Administration shall purchase vehicles based on this standard beginning in the Fall of 1992. The following summarizes the major issues effecting vehicle emissions and their regulation, and present a methodology for procuring clean-fuel vehicles for the State of Washington. Washington State's air quality problems are much less severe than in other parts of the country such as California, the East Coast and parts of the Mid West. Ozone, which is arguably the dominant air quality problem in the US, is a recent and relatively minor issue in Washington. Carbon monoxide (CO) represents a more immediate problem in Washington, with most of the state's urban areas exceeding national CO air quality standards. Since the mid-1960's, vehicle tailpipe hydrocarbon and carbon monoxide emissions have been reduced by 96 percent relative to precontrol vehicles. Nitrogen oxide emissions have been reduced by 76 percent. Emissions from currently available vehicles are quite low with respect to in-place exhaust emission standards. Cold-start emissions constitute about 75 percent of the total emissions measured with the Federal Test Procedure used to certify motor vehicles. There is no currently available 'inherently clean burning fuel'. In

1991, 3052 vehicles were purchased under Washington State contract. Provided that the same number are acquired in 1993, the state will need to purchase 915 vehicles which meet the definition of a 'clean-fueled vehicle'. DOE

N93-16435# Department of the Navy, Washington, DC.
SELF-ACTUATING SLIDE VALVE SYSTEM Patent Application
James Cassidy, inventor (to Navy) 8 Jul. 1992 11 p
(AD-D015456; US-Patent-Appl-SN-912954; Navy-Case-73117) Avail: CASI HC A03/MF A01

A self-actuating slide valve system for launching a device in a fluid environment is provided. An interior channel, in which the device is positioned, is provided with first and second openings in its radial walls for allowing the passage of pressurized fluid into the interior channel. The first opening is located at least partially behind a tail end of the device and the second opening is located forward of the first opening. A sleeve is slidably fitted within a portion of the interior channel and around at least a portion of the device. The sleeve is movable between at least a first and second position. In the first position, the sleeve prevents the pressurized fluid from entering the interior channel through the first opening. In the second position, the sleeve allows the pressurized fluid to enter the interior channel through the first opening whereby the pressurized fluid can act on the tail end of the device to launch same through an axial opening of the interior channel. GRA

N93-16452*# Alabama Univ., Huntsville.
THE VARIABLE POLARITY PLASMA ARC WELDING PROCESS: MATHEMATICAL MODEL OF WELDING SYSTEM Final Report
R. J. Hung Jun. 1992 100 p
(Contract NAS8-36955)
(NASA-CR-191430; NAS 1.26:191430) Avail: CASI HC A05/MF A02

Significant advantages of Variable Polarity Plasma Arc (VPPA) welding process include faster welding, fewer repairs, less joint preparation, reduced weldment distortion, and absence of porosity. A mathematical model is presented to analyze the VPPA welding process. Results of the mathematical model were compared with the experimental observation accomplished by the GDI team. Author

N93-16523 ESDU International Ltd., London (England).
CALCULATION METHODS FOR STEADILY LOADED FIXED-INCLINED-PAD THRUST BEARINGS. (GUIDE TO USE OF COMPUTER PROGRAM A9234.)
Dec. 1992 29 p
(ESDU-92034; ISBN-0-85679-840-1) Avail: ESDU

ESDU 92034 provides details of a FORTRAN program that implements the calculation method of ESDU 82029. It allows performance analysis of an existing design, or the design of a bearing to meet selected performance requirements in which case suitable bearing dimensions, subject to any space constraint, are recommended. The predicted performance includes the lubricant film thickness under load, its temperature and flow rate, the power loss, and the bearing temperature. Recommendations are also made on surface finish. Warning messages are output in the following cases, for each of which possible remedial actions are suggested: drain or pad temperature too high, churning losses too great, film thickness too small, pad number too high, ratio of inner to outer pad radius too large, flow rate too great, and lubricant or pad temperature outside usable range. A lubricant database is provided that may be extended or edited. The program applies to Newtonian lubricants in laminar flow. Worked examples illustrate the use of the program. ESDU

N93-16524 ESDU International Ltd., London (England).
CALCULATION METHODS FOR STEADILY LOADED, OFF-SET PIVOT, TILTING PAD THRUST BEARINGS. (GUIDE TO USE OF COMPUTER PROGRAM A9235.)
Dec. 1992 27 p
(ESDU-92035; ISBN-0-85679-841-X) Avail: ESDU

ESDU 92035 provides details of a FORTRAN program that implements the calculation method of ESDU 83004. It allows performance analysis of an existing design, or the design of a bearing dimensions, subject to any space constraint, are recommended. The predicted performance includes the lubricant film thickness under load, its temperature and flow rate, the power loss, and the bearing temperature. Recommendations are also made on surface finish. Warning messages are output in the following cases, for each of which possible remedial actions are suggested: drain or pad temperature too high, churning losses too great, film thickness too small, pad number too high, ratio or inner to outer pad radius too large, flow rate too great, lubricant or pad temperature outside usable range. A lubricant database is provided that may be extended or edited. The program applies to Newtonian lubricants in laminar flow. Worked examples illustrate the use of the program. ESDU

N93-16528 ESDU International Ltd., London (England).
CALCULATION METHODS FOR EXTERNALLY PRESSURISED (HYDROSTATIC) JOURNAL BEARINGS WITH CAPILLARY RESTRICTOR CONTROL. (GUIDE TO USE OF COMPUTER PROGRAM A9237.)
Dec. 1992 25 p
(ESDU-92037; ISBN-0-85679-845-2) Avail: ESDU

ESDU 92037 provides details of a FORTRAN program that implements the calculation method of ESDU 92026. It allows performance analysis of an existing design, or the design of a bearing to meet both stiffness and overload capacity requirements in which case suitable bearing and capillary restrictor dimensions are recommended. The predicted performance includes the journal displacement under load, the power loss, the lubricant flow rate, and the bearing and lubricant temperatures. Warning messages are output in the following cases, for each of which possible remedial actions are suggested: risk of cavitation, lubricant temperature outside usable range, bearing temperature too high, journal displacement too great, risk of half speed whirl, turbulent bearing or capillary flow, and ratio of flow resistance in capillary restrictor to that in recess outside the range of 0.5 to 1.5. A lubricant database is provided that may be extended or edited. The program applies to Newtonian lubricants with laminar flow in the film and capillary restrictors. Worked examples illustrate the use of the program. ESDU

N93-16549# Argonne National Lab., IL.
DYNAMIC STABILITY OF MAGLEV SYSTEMS
Y. Cai, S. S. Chen, T. M. Mulcahy, and D. M. Rote 1992 58 p Presented at the 63d Shock and Vibration Symposium, Las Cruces, NM, 27 Oct. 1992
(Contract W-31-109-eng-38)
(DE92-041104; ANL/CP-77116; CONF-9210176-1) Avail: CASI HC A04/MF A01

Since the occurrence of dynamic instabilities is not acceptable for any commercial maglev systems, it is important to consider the dynamic instability in the development of all maglev systems. This study is to consider the stability of maglev systems based on experimental data, scoping calculations and simple mathematical models. Divergence and flutter are obtained for coupled vibration of a three-degree-of-freedom maglev vehicle on the guideway which consists of double L-shaped aluminum segments attached to a rotating wheel. The theory and analysis developed in this study provides basic stability characteristics and identifies future research needs for maglev system. DOE

N93-16568# Technische Univ., Delft (Netherlands). Materials Science Lab.
WELD POOL OSCILLATION DURING GAS TUNGSTEN ARC WELDING Ph.D. Thesis
You Hong Xiao 1992 173 p
(ETN-92-92796) Avail: CASI HC A08/MF A02

The oscillation behavior of Gas Tungsten Arc (GTA) weld pools in mild steels Fe 360 and in austenitic stainless steel AISI 304 is considered. Special attention is given to the possibility of using the weld pool oscillation behavior as a sensor of weld pool geometry during welding, which is one of the objectives in adaptive control of the welding process. The topics discussed include the theoretical background of the oscillation phenomenon, the direct observation of weld pool oscillation, the experimental determination of the relation between the weld pool geometry and the oscillation frequency both under stationary arc conditions and under traveling arc conditions and the possibility of sensing the weld pool geometry, especially the weld pool penetration, by monitoring the oscillation frequency. ESA

N93-16583 Department of the Navy, Washington, DC.
HIGH TORQUE CAPABLE, SELF LOCKING, VIBRATION ISOLATING FLEXIBLE SHAFT COUPLING STATEMENT OF GOVERNMENT INTEREST Patent Application
Neil Dubois, inventor (to Navy) 24 Jul. 1992 13 p
(AD-D015501; US-Patent-Appl-SN-918086; Navy-Case-73196) CASI HC A03/MF A01

A flexible shaft coupling has first and second rings and with a spacer there-between. Axially projecting pins provided on the first ring are received in bushings provided in the second ring. Each bushing has coaxial rings that permit each ring to compress differently under the torque load carried by the coupling. Vibration attenuation is realized without reducing the torque loads accommodated. GRA

N93-16663*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
IMPLEMENTATION OF ROBOTIC FORCE CONTROL WITH POSITION ACCOMMODATION
Michael J. Ryan Jun. 1992 99 p
(Grant NAGw-1333)
(NASA-CR-191850; NAS 1.26:191850; CIRSSE-118) Copyright Avail: CASI HC A05/MF A02

As the need for robotic manipulation in fields such as manufacturing and telerobotics increases, so does the need for effective methods of controlling the interaction forces between the manipulators and their environment. Position Accommodation (PA) is a form of robotic force control where the nominal path of the manipulator is modified in response to forces and torques sensed at the tool-tip of the manipulator. The response is tailored such that the manipulator emulates a mechanical impedance to its environment. PA falls under the category of position-based robotic force control, and may be viewed as a form of Impedance Control. The practical implementations are explored of PA into an 18 degree-of-freedom robotic testbed consisting of two PUMA 560 arms mounted on two 3 DOF positioning platforms. Single and dual-arm architectures for PA are presented along with some experimental results. Characteristics of position-based force control are discussed, along with some of the limitations of PA. Author

N93-16665*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
INVESTIGATION AND MODIFICATION OF A COMMERCIALLY AVAILABLE TACTILE SENSOR SUITED FOR ROBOTIC APPLICATIONS Thesis
Carolina Creus Aug. 1991 90 p
(Grant NAGw-1333)
(NASA-CR-191833; NAS 1.26:191833; CIRSSE-100) Avail: CASI HC A05/MF A01

Active (dynamic) tactile sensing was explored using a commercially available tactile array sensor. This task requires the redesign of the sensor interface and a full understanding of the old sensor hardware implementation. There were different stages to this research; the first stage involved the reverse engineering of the old tactile sensor. The second stage had to do with the exploration of the characteristics and behavior of the tactile sensor pad. The next stage dealt with the redesign of the sensor interface using the knowledge gained from the previous two stages. Finally, in the last stage, software to control the tactile sensor was developed to aid in the data acquisition process. Author

N93-16920# Oak Ridge National Lab., TN.
INPUT RELEGATION CONTROL FOR GROSS MOTION OF A KINEMATICALLY REDUNDANT MANIPULATOR
M. A. Unseren Oct. 1992 40 p
(Contract DE-AC05-84OR-21400)
(DE93-002735; ORNL/TM-12165) Avail: CASI HC A03/MF A01

This report proposes a method for resolving the kinematic redundancy of a serial link manipulator moving in a three-dimensional workspace. The underspecified problem of solving for the joint velocities based on the classical kinematic velocity model is transformed into a well-specified problem. This is accomplished by augmenting the original model with additional equations which relate a new vector variable quantifying the redundant degrees of freedom (DOF) to the joint velocities. The resulting augmented system yields a well specified solution for the joint velocities. Methods for selecting the redundant DOF quantifying variable and the transformation matrix relating it to the joint velocities are presented so as to obtain a minimum Euclidean norm solution for the joint velocities. The approach is also applied to the problem of resolving the kinematic redundancy at the acceleration level. Upon resolving the kinematic redundancy, a rigid body dynamical model governing the gross motion of the manipulator is derived. A control architecture is suggested which according to the model, decouples the Cartesian space DOF and the redundant DOF. DOE

N93-17010# Westinghouse Savannah River Co., Aiken, SC.
RESISTANCE UPSET WELDING FOR VESSEL FABRICATION
W. R. Kanne, Jr. 1992 16 p Presented at the JOWOG 22D Meeting, Aldermaston (United Kingdom), 29 Sep. - 2 Oct. 1992
(Contract DE-AC09-89SR-18035)
(DE93-000389; WSRC-MS-92-293; CONF-9209237-1) Avail: CASI HC A03/MF A01

Solid-state resistance upset welding has been successfully applied to fabrication of small vessels. The process has advantages compared with the fusion welding processes currently used to join the two halves of such vessels. These advantages result from the improved metallurgical properties of the weld zone and the simplicity of the welding process. Spherical and cylindrical shapes have been fabricated using the upset welding process. Nondestructive and destructive tests have shown excellent weld strength. Storage tests have demonstrated long term compatibility of the welds for cylindrical parts made from 304L stainless steel that have been in storage for eight years. Spherical vessels and reinforced design vessels made from forged 21-6-9 stainless steel have been prepared for storage. DOE

N93-17057*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SADDLE CLAMP ASSEMBLY Patent Application
Charles R. Belrose, inventor (to NASA) 17 Nov. 1992 14 p
(NASA-Case-MFS-28701-1; NAS 1.71:MFS-28701-1;
US-Patent-Appl-SN-977468) Avail: CASI HC A03/MF A01

A saddle clamp assembly is presented. The assembly is comprised of a hollow cylindrical body centered about a longitudinal axis and being diametrically split into semicircular top and bottom sections. Each section has a pair of connection flanges, at opposite ends, that project radially outward. A pair of bolts are retained on the top section flanges and are threadable into nuts retained on the bottom section flanges. A base member is anchored to a central underside portion of the bottom clamp body section and has a pair of connection tabs positioned beneath the bottom clamp body section connection flanges on opposite sides of the clamp axis. A pair of bolts are retained on the base member connection tabs and are threadable into a pair of nuts retainable on a support structure. The connection tab and connection flanges on each side of the clamp body are axially offset in a manner permitting downward installation/removable tool access to the lower bolts past the connection flanges. An elongated retention tether is used to connect the top clamp body section to the balance of the clamp assembly. This prevents loss of the top clamp body section when it is removed from the bottom clamp body section. NASA

N93-17080*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SLIP JOINT CONNECTOR Patent Application
Frank P. Thomas, inventor (to NASA) 28 Aug. 1992 12 p
(NASA-Case-MFS-28659-1; NAS 1.71:MFS-28659-1;
US-Patent-Appl-SN-936474) Avail: CASI HC A03/MF A01

A slip joint connector for joining first and second structural elements together is presented. The connector has a first body member attachable to the first structural element and a second body member attachable to the second structural element. The first body member has a male protuberance including a conical portion and the second body member has a conical receptacle for cooperatively receiving the conical portion of the protuberance. The protuberance includes a bridging portion for spacing the conical portion from the remainder of the first body member and the second body member has a well communicating with the conical receptacle for receiving the bridging portion. The conical male portion internally carries a nut while the second body member may receive a bolt through the receptacle to be threadedly received by the nut to secure the first and second body members tightly together. NASA

N93-17084*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

RADIAL SPLINE ASSEMBLY FOR ANTIFRICTION BEARINGS Patent Application

Jerry H. Moore, inventor (to NASA) 7 Oct. 1992 14 p

(NASA-Case-MFS-28629-1; NAS 1.71:MFS-28629-1;

US-Patent-Appl-SN-957128) Avail: CASI HC A03/MF A01

An outer race carrier is constructed for receiving an outer race of an antifriction bearing assembly. The carrier in turn is slidably fitted in an opening of a support wall to accommodate slight axial movements of a shaft. A plurality of longitudinal splines on the carrier are disposed to be fitted into matching slots in the opening. A deadband gap is provided between sides of the splines and slots, with a radial gap at ends of the splines and slots and a gap between the splines and slots sized larger than the deadband gap. With this construction, operational distortions (slope) of the support wall are accommodated by the larger radial gaps while the deadband gaps maintain a relatively high springrate of the housing. Additionally, side loads applied to the shaft are distributed between sides of the splines and slots, distributing such loads over a larger surface area than a race carrier of the prior art. NASA

N93-17192# Oak Ridge National Lab., TN.

AN INVERSE DYNAMIC TRAJECTORY PLANNING FOR THE END-POINT TRACKING CONTROL OF A FLEXIBLE MANIPULATOR

D. S. Kwon, S. M. Babcock, and W. J. Book (Georgia Inst. of Tech., Atlanta.) 1992 9 p Presented at the 1992 Korean Automated Control Conference, Seoul (Korea), 19-21 Oct. 1992

(Contract DE-AC05-84OR-21400)

(DE93-000428; CONF-9210174-1) Avail: CASI HC A02/MF A01

A manipulator system that needs significantly large workspace volume and high payload capacity has greater link flexibility than typical industrial robots and teleoperators. If link flexibility is significant, position control of the manipulator's end-effecter exhibits the nonminimum phase, noncollocated, and flexible structure system control problems. This paper addresses inverse dynamic trajectory planning issues of a flexible manipulator. The inverse dynamic equation of a flexible manipulator was solved in the time domain. By dividing the inverse system equation into the causal part and the anticausal part, the inverse dynamic method calculates the feedforward torque and the trajectories of all state variables that do not excite structural vibrations for a given end-point trajectory. Through simulation and experiment with a single-link flexible manipulator, the effectiveness of the inverse dynamic method has been demonstrated. DOE

N93-17271*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SLOW-RELEASE FERTILIZER Patent Application

Douglas W. Ming, inventor (to NASA) and D. C. Golden, inventor (to NASA) 16 Oct. 1992 19 p

(NASA-Case-MSC-21953-1-NP; NAS 1.71:MSC-21953-1-NP;

US-Patent-Appl-SN-963348) Avail: CASI HC A03/MF A01

A synthetic apatite containing agronutrients and a method for making the apatite are disclosed. The apatite comprises crystalline calcium phosphate having agronutrients dispersed in the crystalline structure. The agronutrients can comprise potassium, magnesium, sulfur, iron, manganese, molybdenum, chlorine, boron, copper and zinc in amounts suited for plant growth. The apatite can optionally comprise a carbonate and/or silicon solubility control agent. The agronutrients are released slowly as the apatite dissolves. NASA

N93-17272*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A METHOD FOR SURMOUNTING AN OBSTACLE BY A ROBOT VEHICLE Patent Application

Brian H. Wilcox, inventor (to NASA) and Timothy R. Ohm, inventor (to NASA) 1 Oct. 1992 10 p

(NASA-Case-NPO-18764-1-CU; NAS 1.71:NPO-18764-1-CU;

US-Patent-Appl-SN-956684) Avail: CASI HC A02/MF A01

Surmounting obstacles in the path of a robot vehicle is accomplished by rotating the wheel forks of the vehicle about their transverse axes with respect to the vehicle body so as to shift most of the vehicle weight onto the rear wheels, and then driving the vehicle forward so as to drive the now lightly-loaded front wheels (only) over the obstacle. Then, after the front wheels have either surmounted or completely passed the obstacle (depending upon the length of the obstacle), the forks are again rotated about their transverse axes so as to shift most of the vehicle weight onto the front wheels. Then the vehicle is again driven forward so as to drive the now lightly-loaded rear wheels over the obstacle. Once the obstacle has been completely cleared and the vehicle is again on relatively level terrain, the forks are again rotated so as to uniformly distribute the vehicle weight between the front and rear wheels. NASA

N93-17389# General Atomic Co., San Diego, CA.

DESIGN AND ANALYSIS OF THE CRYOPUMP FOR THE D3-D ADVANCED DIVERTOR

E. Reis, I. Almajan, C. B. Baxi, M. J. Schaffer, D. L. Sevier, J. P. Smith, and M. M. Menon (Oak Ridge National Lab., TN.) Sep. 1992 5 p Presented at the 17th Symposium on Fusion Technology, Rome (Italy), 14-18 Sep. 1992

(Contract DE-AC03-89ER-51114)

(DE93-001357; GA-A-21016; CONF-920930-7) Avail: CASI HC A01/MF A01

A cryocondensation pump for the DIII-D advanced divertor program is to be installed in the vacuum vessel in the fall of 1992. The purpose of the cryopump is to remove gas from the divertor, reduce recycling to the plasma, and to provide reduced density plasmas for experimental study. The pump is designed for a pumping speed of 50,000 l/s at 0.4 mtorr. The major pump components are toroidally continuous to minimize inductive voltages, thereby greatly reducing the risk of any electrical breakdown during disruptions. The cryopump consists of a 25 mm Inconel tube, 10 m long, cooled by liquid helium. It is surrounded by liquid nitrogen-cooled shields and a segmented ambient temperature radiation/particle shield. The outer nitrogen shield has a toroidally discontinuous copper coating to enhance thermal conductivity while maintaining a high toroidal electrical resistance to minimize electromagnetic loads during disruptions. The pump is cooled by 10 g/s of liquid helium at an inlet pressure of 115 kPa and temperature of 4.35 K. The pump is subjected to a steady-state heat load of less than 10 W due to conduction and radiation heat transfer. The helium tube will be subjected to Joule heating of less than 182J due to induced current and a particle load of less than 20 W during plasma operation. Thermal analysis and tests show that the helium tube can absorb a transient heat load of up to 100 W for 10 s and still pump deuterium at 6.3 K. DOE

N93-17481# Oak Ridge National Lab., TN.

AUTOMATIC TUNING FOR A TELEOPERATED ARM CONTROLLER

R. L. Kress and J. F. Jansen 1992 5 p Presented at the 31st IEEE Conference on Decision and Control, Tuscon, AZ, 16-18 Dec. 1992

(Contract DE-AC05-84OR-21400)

(DE93-001647; CONF-921228-1) Avail: CASI HC A01/MF A01

This paper addresses the problem of determining an optimal set of gains for a controller for a teleoperated arm. Specifically, an automatic tuning technique was applied and investigated for tuning an independent-joint proportional-derivative controller for a teleoperated manipulator. The Hooke and Jeeves method is used in conjunction with a one-dimensional search routine in the tuning algorithm. The algorithm was used to optimize gains for a two-link teleoperator simulation and the results of several optimizations were used to determine the best form for an input trajectory and cost function. The desired joint angle trajectory is taken from low-pass filtered step inputs with randomly generated magnitudes, which vary at a predetermined interval. Both positive and negative angles are generated, but they are constrained to lie within the manipulator work space. It was determined that the cost function should be based on tracking error, peak position error over the entire desired path, overshoot, actuator torque bounds, and gain limits. The optimized gains obtained from the simulation were applied to an actual teleoperator and some improvement was seen. DOE

N93-17493# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).

AUTONOMOUS ENVIRONMENT MODELING BY A MOBILE ROBOT Ph.D. Thesis - Toulouse Univ.

Philippe Moutarlier 1991 191 p In FRENCH Sponsored by CIFRE

(LAAS-91381; ETN-92-92548) Avail: CASI HC A09/MF A02

Internal geometric representation of the environment is considered. The autonomy of a mobile robot partly relies on its ability to build a

reliable representation of its environment. On the other hand, an autonomous environment building process requires that model be adapted to plan motions and perception actions. Therefore, the modeling process must be a reversible interface between perception motion devices and the model itself. Several kinds of models are necessary in order to achieve an autonomous process. Sensors give stochastic information on the surface, navigation needs free-space representation, and perception planning requires aspect graphs. The functions of stochastic surface modeling, free space representation, and topological graph computing are presented through the integrated geometric model builder called 'Yaka.' Since all environment data uncertainties are correlated together through the robot location inaccuracy, classical filtering methods are inadequate. A method of computing a linear variance estimator, that is adapted to the problem, is proposed. This general formalism is validated by a large number of experimentation wherein the robot incrementally builds a surfacic representation of its environment. Free space cannot be deduced directly, at each step, from the surfacic data provided by the sensors. Innacuracies on object surfaces and uncertainties on the visibility of objects by the sensor as well as the possible motion of objects must all be taken into account for building the free space incrementally. Then, motion and perception planning for autonomous environment modeling are achieved using this free space model and topological location and aspect graphs. ESA

N93-17577# Northest Sustainable Energy Association, Greenfield, MA.
S/EV 92 (SOLAR AND ELECTRIC VEHICLES): PROCEEDINGS, VOLUME 1
1992 241 p Presented at the Northeast Sustainable Energy Association Meeting, Boston, MA, 9-10 Oct. 1992
(DE93-001501; CONF-9210183-Vol-1) Avail: CASI HC A11/MF A03

Volume 1 of these proceedings presents current research on solar and electric powered vehicles. Both fundamental and advanced concepts concerning electric vehicles are presented. The use of photovoltaic cells in electric vehicles and in a broader sense as a means of power generation are discussed. Information on electric powered fleets and races is included. And policy and regulations, especially pertaining to air quality and air pollution abatement are presented. DOE

N93-17579# EG and G Energy Measurements, Inc., Idaho Falls.
DEVELOPMENT OF TEST PROCEDURES FOR HYBRID/ELECTRIC VEHICLES
A. F. Burke Jul. 1992 98 p
(Contract DE-AC07-76ID-01570)
(DE93-001943; DOE/ID-10385) Avail: CASI HC A05/MF A02

This report is concerned with the development of procedures for testing of hybrid/electric vehicles to determine their energy consumption and emissions characteristics. Special emphasis is given to hybrid vehicles, which can be operated above some minimum battery state-of-charge in an all-electric mode for all types of driving (city and highway). When the all-electric range of these vehicles is exceeded, the vehicles are operated in the hybrid mode, in which an engine/generator is turned on to generate electricity on-board the vehicle. Key issues in testing hybrid vehicles are identified and discussed. These issues include the test cycles to be used, the instrumentation required, the effect of battery state-of-charge and control strategy in the hybrid mode on the need for repeated test cycles, and the data to be collected and how that data from repeated cycles is interpreted to determine the vehicle energy consumption and emissions characteristics. DOE

N93-17583# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
PREDESIGN OF A SIMULATOR FOR INVERSE ROBOT KINEMATICS
R. J. P. Groothuizen 30 Jun. 1990 70 p
(Contract NIVR-427-02305N)
(NLR-TP-91098-U; ETN-92-92518) Copyright Avail: CASI HC A04/MF A01

An inverse robot kinematics method, which is being developed to be applicable to any sequential rigid robot, is considered. Requirements are identified and a survey of existing methods is given. An evaluation of these methods with respect to the requirements shows that a method based on optimization is the best candidate. It satisfies most requirements; the feasibility of the performance requirements still has to be demonstrated. For this, a simulator is required enabling computer experiments with the method. The predesign for this simulator is presented. It is specified such that from the simulator an operational inverse kinematics method can be derived that can be used for path planning and simulation initialization. ESA

N93-17625* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DOUBLE-V BLOCK FINGERS WITH CRUCIFORM RECESS Patent
George M. Voellmer 12 Jan. 1993 7 p Filed 17 Jun. 1992 Continuation of abandoned US-Patent-Appl-SN-760634, filed 16 Sep. 1991
(NASA-Case-GSC-13356-2; US-Patent-5,178,431;
US-Patent-Appl-SN-899145; US-Patent-Class-294-86.4;
US-Patent-Class-294-902; US-Patent-Class-901-39;
US-Patent-Class-269-270; Int-Patent-Class-B25J-15/08) Avail: US Patent and Trademark Office

In a robot having a gripper including a pair of fingers and a drive motor for driving the fingers toward and away from one another while the fingers remain parallel to each other, the fingers consist of finger pads, which interface with a handle on an object to be grasped, and a shank, which attaches the fingers to the robot gripper. The double-V finger has two orthogonal V-grooves forming in the center of the finger pads and recessed cruciform. The double-V finger is used with a handle on the object to be grasped which is the negative of the finger pads. The handle face consists of V-shaped pads capped with a rectangular cruciform. As the gripper is brought into place near the handle, the finger pads are lined up facing the handle pads. When the finger pad and the handle pad are in proper alignment, the rectangular ridges on the handle fall inside the rectangular grooves on the finger, and the grip is complete.
Official Gazette of the U.S. Patent and Trademark Office

N93-17718# Naval Postgraduate School, Monterey, CA.
FORCE OVERRIDE RATE CONTROLLER FOR REMOTE ACTUATION M.S. Thesis
James M. Syvertsen Sep. 1992 79 p
(AD-A257631) Avail: CASI HC A05/MF A01

Many remotely operated robotic manipulator systems are operated in rate control mode to achieve a commanded position and orientation of the end-effector. Performance of certain tasks, such as applying a torque to a screw, would be more efficient if performed in unilateral force control mode. A six axis force-torque model was developed to determine the require number and positioning of sensors and using force sensing resistors, a prototype force-torque transducer was built for testing. Using a force error signal, individual joint angles may be computed in and algorithm to achieve force replication in the end-effector. GRA

N93-17772*# Georgia Inst. of Tech., Atlanta. School of Textile and Fiber Engineering.
AN INDUSTRIAL SEWING MACHINE VARIABLE SPEED CONTROLLER
Christa Estes, Charles Spiggle, Shannon Swift, Stephen VanGeffen, and Frank Youngner [1992] 6 p
(Contract NASw-4435)
(NASA-CR-192066; NAS 1.26:192066) Avail: CASI HC A02/MF A01

The apparel industry is attempting to move in a new direction in the coming decade. Since the invention of an electrically powered sewing machine, the operator has been seated. Today, companies are switching from a sit down operation to a stand up operation involving modular stations. The old treadle worked well with the sitting operator, but problems have been found when trying to use the same treadle with a standing operator. This report details a new design for a treadle to operate an industrial sewing machine that has a standing operator. Emphasis is placed on the ease of use by the operator, as well as the ergonomics involved. Procedures for testing the design are included along with possible uses for the treadle in other applications besides an industrial sewing machine.
Author

N93-17774*# Georgia Inst. of Tech., Atlanta. School of Textile and Fiber Engineering.
DUST CONTROL FOR ENABLER
Kevin Hilton, Chad Karl, Mark Litherland, David Ritchie, and Nancy Sun [1992] 5 p
(Contract NASw-4435)
(NASA-CR-192065; NAS 1.26:192065) Avail: CASI HC A01/MF A01

The dust control group designed a system to restrict dust that is disturbed by the Enabler during its operation from interfering with astronaut or camera visibility. This design also considers the many different wheel positions made possible through the use of artinuation joints that provide the steering and wheel pitching for the Enabler. The system uses a combination of brushes and fenders to restrict the dust when the vehicle is moving in either direction and in a turn. This design also allows for each of maintenance as well as accessibility of the remainder of the vehicle. Author

N93-17280*# California State Polytechnic Univ., Pomona. Dept. of Chemical and Materials Engineering.
HEAT FLOW IN VARIABLE POLARITY PLASMA ARC WELDS
Amanie N. Abdelmessih *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 6 p (For primary document see N93-17279 05-80)
Avail: CASI HC A02/MF A03

N93-17283*# Alabama Univ., Huntsville. Dept. of Mechanical and Aerospace Engineering.
DESIGN AND ANALYSIS OF SEALS FOR EXTENDED SERVICE LIFE
Mark V. Bower *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17284*# Jackson State Univ., MS. School of Science and Technology.
SHUTTLE FLIGHT EXPERIMENT PRELIMINARY PROPOSAL: DEMONSTRATION OF WELDING APPLICATIONS IN SPACE
William V. Brewer *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17318*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
SIMULATION OF CRYOGENIC TURBOPUMP ANNULAR SEALS
Alan B. Palazzolo *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17326*# Alabama Univ., Tuscaloosa. Dept. of Engineering Mechanics.
DESIGN OF A WELDED JOINT FOR ROBOTIC, ON-ORBIT ASSEMBLY OF SPACE TRUSSES
William K. Rule *In its* 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N93-15664# Ames Lab., IA.
DEVELOPMENT AND APPLICATIONS OF A NEW COMPUTER-CONTROLLED MAGNETIC INSPECTION SYSTEM Ph.D. Thesis
A. R. Eichmann Jul. 1992 131 p
(Contract W-7405-eng-82)
(DE92-040579; IS-T-1444) Avail: CASI HC A07/MF A02

The magnetic hysteresis inspection technique has been shown to obtain results that can be traceable to the fundamental properties of the material. A new computer-controlled instrument known as the Magnescope Mark 2 was developed which can be used to make magnetic hysteresis inspections on materials in situ. These inspections can be used to evaluate the condition of steel components non-destructively allowing it to be used in applications such as quality control and assurance in the production of steel and for evaluating the structural integrity of steel components. Previous inspections systems based on this technique were large, heavy, and hard to use making measurements out in the field difficult to obtain. The Magnescope Mark 2 was designed to be smaller, lighter, and easier to use allowing field measurements to be obtained much easier. The design and construction of the Magnescope Mark 2 is described along with the improvements and additions made to the control and analysis software known as MAGNUM. DOE

N93-15837# Iowa State Univ. of Science and Technology, Ames. Center for Nondestructive Evaluation.
NDE FOR THICK SECTION COMPOSITES Quarterly Report, 1 Jul. - 30 Sep. 1991
23 Sep. 1992 20 p
(Contract N00014-86-K-0799)
(AD-A257292) Avail: CASI HC A03/MF A01

The purpose of this work is to permit the calculation of allowed elastic wave modes and directions for nondestructive evaluation of thick composites. In addition, the anisotropic elastic moduli so obtained will contain important information about the microstructure of the material and the vibration characteristics of structures made from it. As the material has been found to be highly anisotropic, it is expected that ultrasonic interrogation to find flaws will be complicated. To calculate the wave propagation phenomena which may be useful or detrimental, it is necessary to measure the elastic moduli of the material. GRA

N93-16040# Florida State Univ., Tallahassee. Dept. of Statistics.
OPTIMAL ALLOCATION UNDER PARTIAL ORDERING OF LIFETIMES OF COMPONENTS
Emad El-Neweihi (Chicago Univ., IL.) and Jayaram Sethuraman Aug. 1992 14 p
(Contract DAAL03-90-G-0103)
(AD-A255577; FSU-TR-M-873; ARO-D-128) Avail: CASI HC A03/MF A01

Assembly of systems to maximize reliability when certain components of the systems can be bolstered in different ways is an important theme in reliability theory. This is done under assumptions of various stochastic orderings among the lifetimes of the components and the spares used to bolster them. The powerful techniques of Schur and AI functions are used in this paper to pinpoint optimal allocation results in different settings involving active and standby redundancy allocation, minimal repair and shock, threshold models. GRA

N93-16657*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
A MULTIPLE OBJECTIVE OPTIMIZATION APPROACH TO QUALITY CONTROL
Christopher Michael Seaman Apr. 1991 223 p
(Grant NAGw-1333)
(NASA-CR-191872; NAS 1.26:191872; CIRSSE-89) Avail: CASI HC A10/MF A03

The use of product quality as the performance criteria for manufacturing system control is explored. The goal in manufacturing, for economic reasons, is to optimize product quality. The problem is that since quality is a rather nebulous product characteristic, there is seldom an analytic function that can be used as a measure. Therefore standard control approaches, such as optimal control, cannot readily be applied. A second problem with optimizing product quality is that it is typically measured along many dimensions: there are many apsects of quality which must be optimized simultaneously. Very often these different aspects are incommensurate and competing. The concept of optimality must now include accepting tradeoffs among the different quality characteristics. These problems are addressed using multiple objective optimization. It is shown that the quality control problem can be defined as a multiple objective optimization problem. A controller structure is defined using this as the basis. Then, an algorithm is presented which can be used by an operator to interactively find the best operating point. Essentially, the algorithm uses process data to provide the operator with two pieces of information: (1) if it is possible to simultaneously improve all quality criteria, then determine what changes to the process input or controller parameters should be made to do this; and (2) if it is not possible to improve all criteria, and the current operating point is not a desirable one, select a criteria in which a tradeoff should be made, and make input changes to improve all other criteria. The process

is not operating at an optimal point in any sense if no tradeoff has to be made to move to a new operating point. This algorithm ensures that operating points are optimal in some sense and provides the operator with information about tradeoffs when seeking the best operating point. The multiobjective algorithm was implemented in two different injection molding scenarios: tuning of process controllers to meet specified performance objectives and tuning of process inputs to meet specified quality objectives. Five case studies are presented. Author

N93-16724*# Mid-South Engineering, Nashville, TN.
WELDSMART: A VISION-BASED EXPERT SYSTEM FOR QUALITY CONTROL Final Report
Kristinn Andersen, Robert Joel Barnett, James F. Springfield, and George E. Cook Sep. 1992 151 p
(Contract NAS8-37685)
(NASA-CR-191410; NAS 1.26:191410) Avail: CASI HC A08/MF A02

This work was aimed at exploring means for utilizing computer technology in quality inspection and evaluation. Inspection of metallic welds was selected as the main application for this development and primary emphasis was placed on visual inspection, as opposed to other inspection methods, such as radiographic techniques. Emphasis was placed on methodologies with the potential for use in real-time quality control systems. Because quality evaluation is somewhat subjective, despite various efforts to classify discontinuities and standardize inspection methods, the task of using a computer for both inspection and evaluation was not trivial. The work started out with a review of the various inspection techniques that are used for quality control in welding. Among other observations from this review was the finding that most weld defects result in abnormalities that may be seen by visual inspection. This supports the approach of emphasizing visual inspection for this work. Quality control consists of two phases: (1) identification of weld discontinuities (some of which may be severe enough to be classified as defects), and (2) assessment or evaluation of the weld based on the observed discontinuities. Usually the latter phase results in a pass/fail judgement for the inspected piece. It is the conclusion of this work that the first of the above tasks, identification of discontinuities, is the most challenging one. It calls for sophisticated image processing and image analysis techniques, and frequently ad hoc methods have to be developed to identify specific features in the weld image. The difficulty of this task is generally not due to limited computing power. In most cases it was found that a modest personal computer or workstation could carry out most computations in a reasonably short time period. Rather, the algorithms and methods necessary for identifying weld discontinuities were in some cases limited. The fact that specific techniques were finally developed and successfully demosntrated to work illustrates that the general approach taken here appears to be promising for commercial development of computerized quality inspection systems. Inspection based on these techniques may be used to supplement or substitute more elaborate inspection methods, such as x-ray inspections. Author

N93-17048*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RAPID DETECTION AND QUANTIFICATION OF FEATURES SUCH AS DAMAGE OR FLAWS IN COMPOSITE AND METALLIC STRUCTURES Patent Application
Gary L. Farley, inventor (to NASA), Barry T. Smith, inventor (to NASA), Joseph N. Zalameda, inventor (to NASA0, and William P. Winfree, inventor (to NASA) 29 Oct. 1992 27 p
(NASA-Case-LAR-14850-1-CU; NAS 1.71:LAR-14850-1-CU; US-Patent-Appl-SN-969869) Avail: CASI HC A03/MF A01

An apparatus, system, and method for non-destructible evaluation (NDE) of a material use thermography to rapidly detect and/or generally locate a feature such as, for example, damage or a defect in the material. The apparatus, system, and method also use ultrasound to specifically locate the feature in the material for quantification and/or evaluation either by an operator or by an external device suited for such purpose. Accordingly, the apparatus, system and method are particularly useful for NDE in applications such as the analysis of the structure of an aircraft, for example, in which the scale of the material to be analyzed is large, thus requiring the rapid NDE afforded by thermography, and in which quantification and/or evaluation of a feature must be performed with precision, thus requiring the relatively high-resolution NDE afforded by ultrasound. NASA

N93-16788*# Troy State Univ., Norfolk Naval Base, VA. Dept. of Public Administration and Human Resources Management.
TOTAL QUALITY MANAGEMENT: STRENGTHS AND BARRIERS TO IMPLEMENTATION AND CULTURAL ADAPTATION
Denise V. Siegfeldt, Michael Glenn, and Louise Hamilton *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 173-174 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16789*# South Carolina Univ., Columbia. Dept. of Physics.
ADVANCED NDE RESEARCH IN ELECTROMAGNETIC, THERMAL, AND COHERENT OPTICS
S. Ballou Skinner *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 175 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17322*# California State Univ., Fullerton. Dept. of Civil Engineering.
RELIABILITY ANALYSIS OF EXTERNAL TANK ATTACK RING (ETA)
Chandra S. Putcha *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17328*# University of Western Illinois, Macomb. Dept. of Mathematics.
RELIABILITY EVALUATION METHODOLOGY FOR NASA APPLICATIONS
Vidya S. Taneja *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17332*# California Polytechnic State Univ., San Luis Obispo. Dept. of Materials Engineering.
UPT SCENARIOS: IMPLICATIONS FOR SYSTEM RELIABILITY
Daniel W. Walsh *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N93-15788*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPUTER PROGRAMS TO CHARACTERIZE ALLOYS AND PREDICT CYCLIC LIFE USING THE TOTAL STRAIN VERSION OF STRAINRANGE PARTITIONING: TUTORIAL AND USERS MANUAL, VERSION 1.0
James F. Saltsman Washington Dec. 1992 31 p
(RTOP 590-21-11)
(NASA-TM-4425; E-6906; NAS 1.15:4425) Avail: CASI HC A03/MF A01

This manual presents computer programs for characterizing and predicting fatigue and creep-fatigue resistance of metallic materials in the high-temperature, long-life regime for isothermal and nonisothermal fatigue. The programs use the total strain version of Strainrange Partitioning (TS-SRP). An extensive database has also been developed in a parallel effort. This database is probably the largest source of high-temperature, creep-fatigue test data available in the public domain and can be used with other life prediction methods as well. This users manual, software, and database are all in the public domain and are available through COSMIC (382 East Broad Street, Athens, GA 30602; (404) 542-3265, FAX (404) 542-4807). Two disks accompany this manual. The first disk contains the

source code, executable files, and sample output from these programs. The second disk contains the creep-fatigue data in a format compatible with these programs. Author

N93-15881# Los Alamos National Lab., NM.
MODELS OF HIGH VELOCITY IMPACT PHENOMENA
C. A. Wingate, R. F. Stellingwerf, R. F. Davidson, and M. W. Burkett 1992 20 p Presented at the High Velocity Impact Symposium, Austin, TX, Dec. 1992
(Contract W-7405-eng-36)
(DE92-017452; LA-UR-92-1982; CONF-921221-1) Avail: CASI HC A03/MF A01

Models of craters formed by impacts at velocities of up to 27 km/sec have been computed using the Smooth Particle Hydrodynamics, MESA, EPIC and CALE codes. These modeling efforts will be compared to data obtained from the Hypervelocity Microparticle Impact project at Los Alamos using the van de Graaff accelerator. This work aids in understanding the fine features and scaling laws found in the experimental results. DOE

N93-15915# Pennsylvania State Univ., University Park. Applied Research Lab.
ADAPTIVE FEEDFORWARD CONTROL OF STRUCTURAL INTENSITY IN A BEAM
A. E. Schwenk, S. D. Sommerfeldt, and S. I. Hayek Oct. 1992 105 p
(Contract N00039-88-C-0051)
(AD-A256780; TR-92-05) Avail: CASI HC A06/MF A02

This study examines methods for the adaptive control of structural vibration intensity in a beam. An algorithm, using finite difference techniques, is developed to calculate the total, instantaneous structural intensity. In addition, algorithms based on the filtered-x least-mean-squares algorithm are developed to adaptively control the intensity. A real-time system identification algorithm is also described. To investigate the effectiveness of adaptive control of structural intensity, three control actuator and two error sensor configurations are used. Adaptive control is implemented at resonance and off-resonance frequencies, and the performance is evaluated by means of a separate accelerometer located in the farfield. Experimental results demonstrate several trends. First, controlling the acceleration is considerably more effective with the error sensor located in the farfield than in the nearfield. Furthermore, controlling acceleration is more effective than controlling intensity, when the error sensors are in the farfield. Conversely, when the error sensors are in the nearfield, the attenuation achieved by controlling intensity is comparable to or greater than that achieved by controlling acceleration. GRA

N93-15958# SRI International Corp., Menlo Park, CA.
MODELING OF MICROSTRUCTURAL EFFECTS ON FRACTURE PROCESSES AT HIGH LOADING RATES Final Report, 1 Feb. 1989 - 31 May 1992
Jacques H. Giovanola, Richard W. Klopp, and D. A. Shockey Jun. 1992 210 p
(Contract F49620-89-K-0003)
(AD-A255684; AFOSR-92-0879TR) Avail: CASI HC A10/MF A03

We extended classical dynamic fracture mechanics to a class of new commercially useful titanium microstructures and demonstrated that their dynamic fracture behavior differs significantly from that of previously studied model materials. By combining continuum measurements (obtained using the torsion split Hopkinson bar and one-point-bend fracture test methods) and fractogaphic measurements (obtained using fracture surface topography analysis, FRASTA), we generated a complete data base on static and dynamic strength and fracture toughness for various microstructures of the alloy Ti-IOV-2Fe-3Al. We determined effects of microstructural features on microfailure behavior and we modeled some of the observed microfailure processes using finite element analysis. Whereas the dynamic initiation toughness was only moderately higher than the static initiation toughness (at most 20 percent), a very strong rise was found in the crack propagation toughness with crack extension (as much as a 100 percent increase) for velocities as low as 100 m/s. This rate dependent resistance curve effect is an intrinsic material property (in contrast to a structural effect) and a strong function of microstructure. We demonstrated that the formation of shear lips is also a strongly rate dependent phenomenon and that shear lips, when they develop, make only a modest contribution to the propagation toughness (on the order of 20 percent for the case studied here). Our results also showed that, in general, there is not a direct correlation between the dynamic initiation and propagation toughnesses. GRA

N93-15972# Sandia National Labs., Albuquerque, NM.
NUMERICAL AND EXPERIMENTAL STUDIES OF HIGH-VELOCITY IMPACT FRAGMENTATION
M. E. Kipp, D. E. Grady, and J. W. Swegle 27 Aug. 1992 30 p Presented at the Hypervelocity Impact Symposium, Austin, TX, 17-20 Nov. 1992
(Contract DE-AC04-76DP-00789)
(DE92-041145; SAND-91-2856C; CONF-921162-7) Avail: CASI HC A03/MF A01

Developments are reported in both numerical and experimental capabilities for characterizing the debris spray produced in penetration events. We have performed a series of high-velocity experiments specifically designed to examine the fragmentation of the projectile during impact. High-strength, well-characterized steel spheres (6.35 mm diameter) were launched with a two-stage light-gas gun to velocities in the range of 3 to 5 km/s. Normal impact with PMMA plates, thicknesses of 0.6 to 11 mm, applied impulsive loads of various amplitudes and durations to the steel sphere. The extent of fragmentation, loss in momentum, and divergence of the debris are shown to correspond to the impact conditions. Multiple flash radiography was used to monitor material motion and fragmentation of the steel sphere during the impact event. Dynamic fragmentation theories, based on energy-balance principles, were used to evaluate local material deformation and fracture state information from CTH, a three-dimensional Eulerian solid dynamics shock wave propagation code. The local fragment characterization of the material defines a weighted fragment size distribution, and the sum of these distributions provides a composite particle size distribution for the steel sphere. The calculated axial and radial velocity changes agree well with experimental data, and the calculated fragment sizes for a specific experiment are in qualitative agreement with the radiographic data. DOE

N93-15986# Naval Postgraduate School, Monterey, CA.
EFFECTS OF INTERFACIAL DEBONDING AND FIBER BREAKAGE ON STATIC AND DYNAMIC BUCKLING OF FIBERS EMBEDDED IN MATRICES M.S. Thesis
Metin Serttunc Sep. 1992 44 p
(AD-A257326) Avail: CASI HC A03/MF A01

Analyses were performed for static and dynamic buckling of a continuous fiber embedded in a matrix in order to determine the effects of interfacial debonding and fiber breakage on the critical buckling load and the domain of instability. A beam on elastic foundation model was used. The study showed that a local interfacial debonding between a fiber and a surrounding matrix resulted in an increase of the wavelength of the buckling mode. An increase of the wave length yielded a decrease of the static buckling load and lowered the dynamic instability domain. In general, the effect of a partial or complete interfacial debonding was more significant on the domain of dynamic instability than on the effects of static buckling load. For dynamic buckling of a fiber, a local debonding of size 10 to 20 percent of the fiber length had the most important influence on the domains of dynamic instability regardless of the location of debonding and the boundary conditions of the fiber. For static buckling, the location of a local debonding was critical to a free-simply supported fiber but not to a fiber with both ends simply supported. Fiber breakage also lowered the critical buckling load significantly. GRA

N93-16018# Army Armament Research, Development and Engineering Center, Watervliet, NY. Benet Lab.
AUTOFRETTAGE: STRESS DISTRIBUTION UNDER LOAD AND RETAINED STRESSES AFTER DEPRESSURIZATION Final Report
Boaz Avitzur Jul. 1992 45 p Supersedes ARCCB-TR-89019, AD-A212 090
(AD-A256418; ARCCB-TR-92032; ARCCB-TR-89019) Avail: CASI HC A03/MF A01

There is a long-standing interest in developing a capability to predict the distribution of retained stresses in thick-walled tubes after the removal of an internal pressure-post autofrettage. In this report, four different methods of calculating such stresses are presented and compared. The methods presented are based on the following assumed yield criteria and deformation

conditions: (1) Tresca's yield criterion; (2) Tresca's yield criterion 2/3; (3) Mises' yield criterion in plane-stress; and (4) Mises' yield criterion in plane-strain. GRA

N93-16035# Texas Inst. for Computational Mechanics, Austin.
HIGHLY ACCURATE ADAPTIVE FINITE ELEMENT SCHEMES FOR NONLINEAR HYPERBOLIC PROBLEMS Final Report
J. T. Oden 28 Aug. 1992 100 p
(Contract DAAL03-89-K-0120)
(AD-A256740; ARO-26871.5-MA) Avail: CASI HC A05/MF A02

This document is a final report of research activities supported under General Contract DAAL03-89-K-0120 between the Army Research Office and the University of Texas at Austin from July 1, 1989 through June 30, 1992. The project supported several Ph.D. students over the contract period, two of which are scheduled to complete dissertations during the 1992-93 academic year. Research results produced during the course of this effort led to 6 journal articles, 5 research reports, 4 conference papers and presentations, 1 book chapter, and two dissertations (nearing completion). It is felt that several significant advances were made during the course of this project that should have an impact on the field of numerical analysis of wave phenomena. These include the development of high-order, adaptive, hp-finite element methods for elastodynamic calculations and high-order schemes for linear and nonlinear hyperbolic systems. Also, a theory of multi-stage Taylor-Galerkin schemes was developed and implemented in the analysis of several wave propagation problems, and was configured within a general hp-adaptive strategy for these types of problems. Further details on research results and on areas requiring additional study are given in the Appendix. GRA

N93-16082# Army Armament Research, Development and Engineering Center, Watervliet, NY.
ENVIRONMENTALLY-CONTROLLED FRACTURE OF AN OVERSTRAINED A723 STEEL THICK-WALLED CYLINDER Final Report
J. H. Underwood, V. J. Olmstead, J. C. Askew, A. A. Kapusta, and G. A. Young Aug. 1992 32 p
(AD-A257303; ARCCB-TR-92038) Avail: CASI HC A03/MF A01

A through-wall, 1.7 m long crack grew suddenly from a notch in a 285 mm outer diameter (OD) of an A723 steel overstrained tube that was undergoing plating operations with no externally applied loads. The fracture mechanics tests and analyses and the fractography performed to characterize the cracking are described. The tube had a yield strength of 1200 MPa, fracture toughness of 150 MPavm, and a tensile residual stress at the OD of about 600 MPa. The composition was typical of an air-melt A723 steel, and the electropolishing bath, consisting of sulfuric and phosphoric acids, was held at 54 C. The bolt-loaded test for the threshold stress intensity factor for environmentally controlled cracking described by Wei and Novak was used here with two significant modifications. Some tests included only a notch with the radius matching that of the tube, and a new expression for K in terms of crack-mouth displacement was developed and used. Scanning electron microscope fractography and energy dispersive x ray spectra were used to identify crack mechanisms. Results of the study include: (1) a measured threshold of hydrogen stress cracking for the material/environment below 20 MPavm; (2) da/dt versus K behavior typical of classic environmental control; and (3) an improved K/v expression for the bolt-loaded specimen and associated criteria for determining plane-strain test conditions in relation to the Irwin plastic zone. GRA

N93-16097# Oak Ridge National Lab., TN.
HERMITE INTERPOLATION ALGORITHM FOR 2D FRACTURE MECHANICS
D. O. Potyondy, A. R. Ingraffea (Cornell Univ., Ithaca, NY.), and L. J. Gray 26 Mar. 1992 4 p Presented at the IABEM-2 International Association for Boundary Elements Meeting, Boulder, CO, 2-5 Aug. 1992
(Contract DE-AC05-84OR-21400)
(DE92-041266; CONF-9208159-1) Avail: CASI HC A01/MF A01

For boundary element fracture analysis hypersingular equations provide an efficient alternative to the multidomain method. This is especially true if the goal is to simulate crack growth, as remeshing for a multidomain calculation then becomes a major problem. For a simple nodal collocation approximation, the numerical implementation of the hypersingular equation must use a differentiable interpolation of the boundary displacement function. This smoothness requirement is not present in standard boundary integral methods. Alternative approaches to Overhauser elements are of interest, and herein a two dimensional Hermite interpolation algorithm for fracture mechanics is presented. In this approach, a C sup 1 interpolation is achieved by explicitly incorporating the nodal tangential derivatives as additional variables in the approximation. These extra unknowns are determined by using the tangential derivative of the boundary integral equation. For a crack problem however, there are not enough equations to solve for the derivatives on both sides of the crack. In the method presented, the extra equations are obtained by collocating at the midpoint of each crack element. DOE

N93-16188# Lehigh Univ., Bethlehem, PA.
THE INTERFACE CRACK PROBLEM IN NONHOMOGENEOUS BONDED MATERIALS OF FINITE THICKNESS Final Report
Yaofeng Chen and F. Erdogan Aug. 1992 290 p
(Contract N00014-89-C-3188)
(AD-A256990) Avail: CASI HC A13/MF A03

In a recently developed material forming method called Functionally Gradient Materials as well as applications of material deposition processes such as ion plating, composite materials are being created where the interface possesses a gradually varying material composition and properties. This study was directed at the mechanics of such materials when there is a crack on the interface, and sought to find parameters that govern the crack growth such as the crack tip stress intensity factors, strain energy release rate and probable direction of crack extension. The mixed boundary value problem involved two bonded materials having finite thicknesses with an interface crack under plane strain or generalized plane stress conditions. One material is homogeneous and the other nonhomogeneous with an exponential property variation in the y-direction. Fourier transforms was applied to Navier's equations to derive a system of singular integral equations with a simple Cauchy kernel and Fredholm kernels. The x-derivatives of the two crack opening displacements are assumed to be the unknowns. Extensive asymptotic expansions of the kernels, which were the algebraic sum of rational functions of 7 by 7 and 8 by 8 determinants as the numerator and denominator were carried out in order to separate the Cauchy kernel and to facilitate the integral equations numerical computation. The problem was solved numerically by converting to a system of linear algebraic equations and by using a collocation technique. The stress field near the crack tip is mixed mode and is shown to have a standard square root singularity. GRA

N93-16211# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
INITIAL IMPERFECTION SURVEY ON A CYLINDRICAL SHELL AT THE ULTRA-CENTRIFUGE NEDERLAND n.v.
A. W. H. Klompe Apr. 1992 24 p
(LR-682; ETN-92-92876) Avail: CASI HC A03/MF A01

The results of the initial imperfection survey of a circular shell, with an inner and outer skin made out of carbon fibers with an aluminum honeycomb in between, are presented. The experimental program and data reduction work (correction program, best fit, and harmonic analysis) are described. The modal components of the measured imperfection surface as a function of the circumferential and axial wave numbers are calculated. The characteristic impecfection distributions associated with the fabrication process used are presented. ESA

N93-16214# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
DAMPING
D. Shilkrut Jun. 1991 56 p
(LR-685; ETN-92-92879) Avail: CASI HC A04/MF A01

An introduction to the theory of vibration damping caused by the phenomenon of dissipation of energy of motion and deformation and implemented by internal factors of the structure is given. The phenomenon of internal energy loss may take place both within the material of the structure itself, or in conjunction between parts of the structure. The internal dissipation in material is generated by local microdeformations due to the microstructure and the complete set of microdefects in real materials. Nonstationary basic phenomena (creep and stress relaxation) generated by viscoplasticity are considered. The steady hysteresis phenomenon and vibration damping effect connected with it are also considered. The theory

of hysteresis is built independently from the above mentioned nonstationary phenomena, despite the fact that they are undoubtedly connected. ESA

N93-16240# Oak Ridge National Lab., TN. Applied Technology Div.
HYDROSTATIC PRESSURE TESTING OF GRAPHITE/EPOXY CYLINDER C6-1
H. W. Blake and J. M. Starbuck Jul. 1992 127 p
(Contract DE-AC05-84OR-21400)
(DE93-000427; ORNL/ATD-64) Avail: CASI HC A07/MF A02

The design, fabrication, and testing is detailed of IM6 graphite cylinder C6-1, which achieved a record pressure in hydrotest without failure. Included are the details of the cylinder construction, the design calculations for stress and buckling, and the cylinder failure predictions. Also provided are the design details of the metal end closures including the design calculations for the linear tapered end plugs. Finally, the test data and observations from the hydrotest are summarized. DOE

N93-16260# Lehigh Univ., Bethlehem, PA.
FRACTURE MECHANICS OF DISSIMILAR MATERIAL BONDED THROUGH AN ORTHOTROPIC INTERFACIAL ZONE Final Report
Fazil Erdogan and Binghua Wu Aug. 1992 56 p
(Contract N00014-89-C-3188)
(AD-A256991) Avail: CASI HC A04/MF A01

The fracture mechanics of orthotropic materials containing collinear interface cracks is considered. The objective is to study the influence of the thickness and the structure of the interfacial regions on the crack driving force. The interfacial region is assumed to be a relatively thin orthotropic elastic layer. The stress intensity factors or the strain energy release rates are assumed to be the main measure of the crack driving force. A relatively simple and efficient method is presented to solve the related elasticity problem. The results are obtained for a wide range of actual material combinations. In order to study the influence of the structure of the interfacial zone, the problem is also solved for isotropic and orthotropic materials bonded through a layer with hypothetically selected material properties. The results show that the effect of the thickness, the mechanical properties and the material orientation of the interfacial zone on the strain energy release rate could be very significant. An intersting and a rather useful result obtained from the collinear crack solutions is that the strain energy release rates for multiple cracks in bonded orthotropic materials with or without an interfacial layer may predicted by using the results obtained for an isotropic homogeneous plane provided the normalization factors are selected properly. GRA

N93-16270# Tennessee Univ., Knoxville.
INTERFERENCE OF WEDGE-SHAPED PROTRUSIONS ON THE FACES OF A GRIFFITH CRACK IN BIAXIAL STRESS
J. A. M. Boulet Apr. 1992 69 p Prepared in cooperation with Oak Ridge National Lab., TN
(Contract DE-AC05-84OR-21400)
(DE92-041375; ORNL/Sub-87-07685/2) Avail: CASI HC A04/MF A01

An initial investigation of the influence of protrusion interference on the fracture toughness required to prevent unstable propagation of a Griffith crack in a brittle material is described. The interference is caused by relative shear displacement of the crack faces when subjected to remote biaxial stress with neither principal stress parallel to the crack. It is shown that for room temperature cracks smaller than about one cm in silicon carbide, or about one mm in silicon nitride, the presence of interference changes the fracture stress. A mathematical model based on linear elasticity solutions and including multiple interference sites at arbitrarily specified positions on the crack is presented. Computations of the change in required fracture toughness and its dependence on wedge geometry (size and vertex angle), applied stresses (orientation and magnitude), and location of the interference site are discussed. Results indicate that a single interference site has only a slight effect on required toughness. However, the influence of interference increases monotonically with the number of interference sites. The two-dimensional model described herein is not accurate when the interference sites are closely spaced. DOE

N93-16282# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
A SEMI-ANALYTICAL FORMULATION FOR THE ELASTOPLASTIC ANALYSIS OF IMPERFECT CYLINDRICAL SHELLS
E. Deerenberg Dec. 1991 78 p
(LR-674; ETN-92-92869) Avail: CASI HC A05/MF A01

A semi-analytical formulation for the elastoplastic analysis of initially imperfect cylindrical shells under axial compression and lateral pressure was developed. The formulation is based on a small strain, moderate rotation shell theory and small strain incremental constitutive theory. The basic shell equations and the partially inverted constitutive relations in total form are reduced to a set of coupled nonlinear algebraic/ordinary differential equations by means of a Fourier decomposition of the state variables, imperfections and loads in circumferential direction of the shell, and application of Galerkin's method. The governing nonlinear equations are solved with an incremental iterative technique. The method of quasilinearization is used to generate the governing equations of the iterative procedure which consistently takes into account both geometrical and material nonlinearities. Plasticity effects are described using a layered approach. The classical flow theory based on the von Mises yield surface, associative flow rule, and the isotropic hardening law is used to describe the evolution of the plastic strains in the integration points. In every iteration a set of linear ordinary differential equations is solved numerically with a shooting method and a return mapping algorithm is used to integrate the constitutive equations locally. A number of elastic and elastoplastic buckling problems are solved for which results are known from literature. It is shown that the quadratic rate of convergence, characteristic for a Newton type iteration procedure, is retained even for large load steps. A comparison between the present results and the results from literature shows a good agreement. ESA

N93-16285# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
MULTIPLE-SITE-DAMAGE FATIGUE OF RIVETED JOINTS
J. Schijve Apr. 1992 27 p Presented at the International Workshop on Structural Integrity of Aging Airplanes, Atlanta, GA, 31 Mar. - 2 Apr. 1992
(LR-679; ETN-92-92874) Avail: CASI HC A03/MF A01

Results of fatigue tests in riveted lap joints, including fractographic observations, are presented and analyzed. They indicate that the load transmission in a riveted lap joint is a rather complex phenomenon, as confirmed by quite different crack initiation mechanisms. It may not be expected that fracture mechanics predicts early crack growth with a practically useful degree of accuracy. Most important, the fractographic analysis reveals, that if there are visible cracks in a riveted lap joint, there are many small cracks at most rivet holes in the same critical row of rivets. A multiple site damage situation is present. The conclusion also applies to fuselage lap joints. Scatter in laboratory tests in riveted lap joint specimens is relatively low. However, scatter of riveted joints in a fleet of aircraft may be larger for several reasons. Crack growth in riveted lap joints may be sufficiently slow to allow a timely detection in service. For aging aircraft this should be confirmed by full scale testing. ESA

N93-16286# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
BUCKLING PROBLEMS OF SANDWICH SHELLS
B. H. Sun Jul. 1992 105 p
(LR-690; ETN-92-92882) Copyright Avail: CASI HC A06/MF A02

Buckling analysis, fundamentally a subtopic of nonlinear rather than linear mechanics, is considered with focus on the buckling of sandwich shell. The concepts of sandwich construction are presented and the sandwich oriented shell theory is given. The buckling theory based on the modified variational principle is given. Since some restrictions were found, for example that boundary conditions are not easily satisfied, a modified form of Koiter's buckling theory is given. The present results showed that there is an interaction between the imperfections and boundary effects, and the symmetry of bifurcation is destroyed if the restrictions are not satisfied. This modified theory is very useful in the finite element method. General results of buckling of sandwich shells were obtained based on the modified buckling theory. Buckling analysis is found to be very important for sandwich constructs. The buckling of sandwich cone was studied in detail. The other form of modified buckling theory based on energy approach is given in the appendix together with the equivalent-cylinder approach for the buckling of sandwich cone. The buckling load, and well known Koiter's circle were obtained. ESA

N93-16292# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

THE WORLD OF GRID METHODS

Piet J. Sevenhuijsen 29 Aug. 1989 24 p Submitted for publication

(NLR-TP-89298-U; ETN-93-92855) Avail: CASI HC A03/MF A01

The existence, the features, and the future of grid methods are discussed. Grid methods were among the first methods applied in experimental mechanics. Lines were drawn on, or scratched in surfaces of structural components and an attempt to observe the displacements and deformations of these lines was carried out. The specific optical set ups and basic formulae are described. The fixed grid method for in plane deformations, for out of plane deformations, also of the projected grid method for out of plane deformations and of the reflected grid method for out of plane deformations, are considered. The grid methods together have a large range of applicabilities. The applicabilities can be improved by using photoelectronic digital image measurement systems. ESA

N93-16346# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

ON FORMULATIONS OF PATH-FOLLOWING TECHNIQUES FOR STRUCTURAL STABILITY ANALYSIS

Eduard Riks Feb. 1992 17 p Presented at European Conference on New Advances in Computational Structural Mechanics, Giens, France, 2-4 Apr. 1992

(LR-676; ETN-93-92871) Avail: CASI HC A03/MF A01

Alternatives in the formulation of path following solution techniques for structural stability problems are considered. The influence of the parameterization on the form of the corrector equations is studied. The use of path following techniques increased in the field of nonlinear solid mechanics. Many nonlinear finite element codes are equipped with a basic path following procedure that can be used to compute the load deformation response of a given structural model up to and past the stability boundary. The results lead to the conclusion that the effect of variations on the performance of the path following procedure cannot be assessed beforehand and there are no indications that one choice offers substantial improvement over others in terms of the overall performance of the path following procedure. This holds when these procedures are designed to deal with a great variety of problems. ESA

N93-16412# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

THE EFFECT OF INITIAL IMPERFECTIONS ON SHELL STABILITY: A REVIEW

J. Arbocz Dec. 1991 165 p

(LR-618; ISBN-90-6275-751-0; ETN-93-92864) Copyright Avail: CASI HC A08/MF A02

The development of the Delft interactive shell design code is described. The purpose of this project is to make the accummulated theoretical, numerical and practical knowledge of the last 20 years accessible to users interested in the analysis of buckling sensitive structures. With this open ended, hierarchical, interactive computer code the user can access from his work station. Semianalytical solutions for the buckling load of perfect anisotropic circular cylindrical shells under axial compression, internal or external lateral pressure and torsion are proposed. Modules that contain Koiter's imperfection sensitivity theory extended to anisotropic shell structures under combined loading are included. The nonlinear Donnel type shell equations in terms of the radial displacement W and the Airy stress function F are used. Simple eigenvalue equations are obtained in terms of the integers m and n, representing the number of half waves in the axial and the number of full waves in the circumferential direction, and Khot's skewedness parameter tau(sub K). Results of the search for the minimum eigenvalue and its imperfection sensitivity are given. ESA

N93-16433# Lehigh Univ., Bethlehem, PA.

THE AXISYMMETRIC CRACK PROBLEM IN A NONHOMOGENEOUS MEDIUM Final Report

M. Ozturk and F. Erdogan Aug. 1992 28 p

(Contract N00014-89-C-3188)

(AD-A256955) Avail: CASI HC A03/MF A01

The axisymmetric crack problem for a nonhomogeneous medium is considered. It is assumed that the shear modulus is a function of z approximated by mu = mu (sub 0) e to the alpha z power. This is a simple simulation of materials and interfacial zones with intentionally or naturally graded properties. The problem is a mixed mode problem and is formulated in terms of a pair of singular integral equations. With fracture mechanics applications in mind, the main results given are the stress intensity factors as a functions of the nonhomogeneity parameter alpha for various loading conditions. Also given are some sample results showing the crack opening displacements. GRA

N93-16609 Department of the Navy, Washington, DC.

IN-LINE LOAD CELL FOR FLEXIBLE STRENGTH MEMBER MATERIALS Patent

Joseph Liguore, inventor (to Navy) 7 Jul. 1992 4 p Filed 27 Aug. 1990

(AD-D015507; US-Patent-5,127,275; US-Patent-Appl-SN-573971; US-Patent-Class-73-862) Avail: US Patent and Trademark Office

An in-line load cell for flexible strength member materials is presented. An aluminum cylindrical body section houses two steel pins that perpendicularly pass through the longitudinal axis of the body section. Both steel pins extend from either side of the body section to provide four wrapping points for a flexible strength member to be tested. The load cell is placed in the line of action of the strength member and the strength member is wrapped about the four wrapping points. The forces exerted on the wrapping points cause bending moments to occur around the steel pins as tension is applied throughout the strength member. A strain gauge mounted on the body section between the two steel pins measures the tension in the flexible member based on the tensile strain in the body section. GRA

N93-16696*# Auburn Univ., AL. Dept. of Mechanical Engineering.

A DYNAMIC STUDY OF FRAGMENTATION AND ENERGY LOSS DURING HIGH VELOCITY IMPACT Final Report, 28 Aug. 1989 - 17 Jul. 1992

Ralph H. Zee 17 Jul. 1992 85 p

(Contract NAS8-37823)

(NASA-CR-184476; NAS 1.26:184476) Avail: CASI HC A05/MF A01

Research conducted under this contract can be divided into two main areas: hypervelocity (in the range up to 7 km/s) and high velocity (less than 1 km/s). Work in the former was performed at NASA-MSFC using the Light Gas Gun Facility. The lower velocity studies were conducted at Auburn University using the ballistic gun. The emphasis of the project was on the hypervelocity phenomenon especially in the characterization of the debris cloud formed by the primary impact events. Special devices were made to determine the angular distributions of momentum and energy of the debris cloud as a function of impact conditions. After several iteration processes, it was decided to concentrate on the momentum effort. Prototype devices were designed, fabricated, and tested. These devices were based on the conservation of momentum. Distributions of the debris cloud formed were measured by determining the amount of momentum transferred from the debris cloud to strategically placed pendulum measurement devices. The motion of the pendula was monitored using itegrated opto-interrupters. The distribution of momentum in the debris cloud was found to be a strong function of the impact condition. Small projectiles at high velocities were observed to produce finely dispersed debris whereas large projectiles generated discrete particles in the debris. Results also show that the momentum in the forward direction was enhanced due to the impact. This phenomenon of momentum multiplication was also observed in other studies and in computer simulations. It was initially planned to determine the energy distribution using deformation energy in a rod with strain gauges. Results from preliminary studies show that this technique is acceptable but too tedious. A new technique was explored based on measuring the heating effect of the debris cloud using an IR camera. The feasibility and sensitivity was established at Auburn University. This type of energy distribution measurement method can easily be adapted to the gas gun facility at MSFC. The objective of the lower velocity studies at Auburn was to simulate the damage produced in advanced materials by the lower energy debris cloud. Author

N93-16946*# California State Univ., San Diego. Dept. of Applied Mechanics and Engineering Sciences.

THE USE OF CROSS-SECTION WARPING FUNCTIONS IN COMPOSITE ROTOR BLADE ANALYSIS Final Technical Report, 15 May 1990 - 1 Jul. 1992

J. B. Kosmatka 1 Jul. 1992 179 p
(Grants NAG1-1151; NSF MSM-88-09132)
(NASA-CR-191772; NAS 1.26:191772; SSRP-92/11) Avail: CASI HC A09/MF A02

During the contracted period, our research was concentrated into three areas. The first was the development of an accurate and a computationally efficient method for predicting the cross-section warping functions in an arbitrary cross-section composed of isotropic and/or anisotropic materials. The second area of research was the development of a general higher-order one-dimensional theory for anisotropic beams. The third area of research was the development of an analytical model for assessing the extension-bend-twist coupling behavior of nonhomogeneous anisotropic beams with initial twist. In the remaining six chapters of this report, the three different research areas and associated sub-research areas are covered independently including separate introductions, theoretical developments, numerical results, and references. Author

N93-16979# Rome Univ. (Italy). Dipt. di Fisica.
AN EXACT SOLUTION IN GAUGE THEORY OF STRAIT DISCLINATIONS IN AN ISOTROPIC ELASTIC MEDIUM
R. V. Konoplich (Istituto Nazionale di Fisica Nucleare, Rome, Italy), E. V. Selivanov (Moscow Physical-Engineering Inst., USSR), and V. P. Zhukov (Moscow Physical-Engineering Inst., USSR) 17 Mar. 1992 12 p
(Preprint-875; ETN-93-92975) Avail: CASI HC A03/MF A01

The gauge model of defects is considered. An exact vortex like solution for an individual static strait wedge disclination with an arbitrary integer Frank index in an infinite isotropic elastic medium is obtained. The solution is topologically stable, continuous, and yields elastic fields subject to standard boundary conditions. ESA

N93-17002# Oak Ridge National Lab., TN.
FRACTURE TOUGHNESS MEASUREMENTS WITH SUBSIZE DISK COMPACT SPECIMENS
D. J. Alexander 1992 28 p Presented at the ASTM International Symposium on Small Specimen Test Techniques and Their Applications To Nuclear Reactor Vessel Thermal Annealing and Plant Life Extension, New Orleans, LA, 29-31 Jan. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001374; CONF-920146-6) Avail: CASI HC A03/MF A01

Special fixtures and test methods have been developed for testing small disk compact specimens (12.5 mm diam by 4.6 mm thick). Both unloading compliance and potential drop methods have been used to monitor crack extension during the J-integral resistance (J-R) curve testing. Provisions have been made to allow the necessary probes and instrumentation to be installed remotely using manipulators for testing of irradiated specimens in a hat cell. Laboratory trials showed that both unloading compliance and potential drop gave useful results. Both techniques gave similar data, and predicted the final crack extension within allowable limits. The results from the small disk compact specimens were similar to results from conventional compact specimens 12.7-mm thick. However, the slopes of the J-R curves from the larger specimens were lower, suggesting that the smaller disk compact specimens may have lost some constraint due to their size. The testing shows that it should be possible to generate useful J-R curve fracture toughness data from the small disk compact specimens. DOE

N93-17005# California Univ., Berkeley. Lawrence Berkeley Lab.
DETERMINATION OF THE STRAIN FIELD FROM AN HREM IMAGE OF A Si LOMER DISLOCATION
K. H. Tsai, A. F. Schwartzman, R. Gallego, M. Ortiz, K. S. Kim, and M. A. OKeefe Mar. 1992 3 p Presented at the Annual Meeting of the Electron Microscopy Society of America, Boston, MA, 16-21 Aug. 1992
(Contract DE-AC03-76SF-00098)
(DE92-041176; LBL-32129; CONF-920819-23) Avail: CASI HC A01/MF A01

A new approach to quantitative deformation characterization of high-resolution electron microscopy (HREM) defect images has been developed. The principle of this technique, (Computational Fourier Transform Deformation (CFTD)) is to extract an accurate displacement field about a defect from its HREM image using Fourier transformation procedures. The methodology's unique feature is to digitize the defect image and compute the Moire pattern, from which the displacement field is obtained, without the need for an external reference lattice image, normally associated with the interference phenomena. From this data, the displacement gradient can be calculated, which yields much information on the experimental deformation mechanics. One question that has arisen is whether different imaging conditions of the same defect affects the results of the CFM analysis. We have studied this problem by analyzing the strain components of simulated images of a Lomer dislocation in Si and present our findings here. DOE

N93-17012# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
BRITTLE TO DUCTILE TRANSITION IN CLEAVAGE FRACTURE
A. S. Argon and Q. Berg 30 Sep. 1992 8 p
(Contract DE-FG02-87ER-45294)
(DE93-002466; DOE/ER-45294/T4) Avail: CASI HC A02/MF A01

The problem of interpretation of fracture transition from brittle to ductile or vice versa is the subject of study. An instrumented tapered double cantilever beam (TDCB) has been developed as a definitive tool in the study of the intrinsic mechanism in single crystalline samples. In this experiment, the crack velocity is directly proportional to actuator velocity. In experiments performed on TDCB shaped Si single crystals, oriented for cleavage on either /111/ or /110/ planes, a number of troubling features of jerky crack extension were encountered. Evidence suggests that nucleation of dislocation loops from crack tip is easier than moving these dislocations away from crack tip. DOE

N93-17366# Los Alamos National Lab., NM.
STATIC-STRESS ANALYSIS OF DUAL-AXIS SAFETY VESSEL
D. H. Bultman Nov. 1992 24 p
(Contract W-7405-eng-36)
(DE93-001860; LA-12435-MS) Avail: CASI HC A03/MF A01

An 8 ft diameter safety vessel, made of HSLA-100 steel, is evaluated to determine its ability to contain the quasi-static residual pressure from a high explosive (HE) blast. The safety vessel is designed for use with the Dual-Axis Radiographic Hydrotest (DARHT) facility being developed at Los Alamos National Laboratory. A smaller confinement vessel fits inside the safety vessel and contains the actual explosion, and the safety vessel functions as a second layer of containment in the unlikely case of a confinement vessel leak. The safety vessel is analyzed as a pressure vessel based on the ASME Boiler and Pressure Vessel Code, Section 8, Division 1, and the Welding Research Council Bulletin, WRC107. Combined stresses that result from internal pressure and external loads on nozzles are calculated and compared to the allowable stresses for HSLA-100 steel. Results confirm that the shell and nozzle components are adequately designed for a static pressure of 830 psi, plus the maximum expected external loads. Shell stresses at the 'shell to nozzle' interface, produced from external loads on the nozzles, were less than 700 psi. The maximum combined stress resulting from the internal pressure plus external loads was 17,384 psi, which is significantly less than the allowable stress of 42,375 psi for HSLA-100 steel. DOE

N93-17606# Battelle Columbus Labs., OH.
AN INVESTIGATION OF THE EFFECTS OF HISTORY DEPENDENT DAMAGE IN TIME DEPENDENT FRACTURE MECHANICS, VARIABLE LOAD CONDITIONS
F. W. Brust, P. Krishnaswamy, and B. S. Majumdar 12 Nov. 1992 18 p
(Contract DE-FG02-90ER-14135)
(DE93-004288; DOE/ER-14135/1) Avail: CASI HC A03/MF A01

The demands for structural systems to perform reliably under severe temperatures and load conditions continue to increase. These demands will continue with the development of advanced power generation methods and for future aerospace applications. An understanding of the high temperature creep crack growth process, which is a frequent failure mechanism in these structures, is important. Many investigations which have appeared to date are concerned with creep crack growth which occurs under a constant load and temperature. However, most structural components experience complicated load histories. The history of degradation and damage which accumulates at the crack tip is greatly influenced by these transients. This program aims at gaining an understanding of the history-dependent high temperature failure process through a combined experimental and analytical effort. Development of a

useful predictive methodology for characterizing this process is being undertaken. DOE

N93-17690# Naval Undersea Warfare Center, New London, CT.
A NONCONFORMING APPROXIMATE SOLUTION TO A SPECIALLY ORTHOTROPIC AXISYMMETRIC THIN SHELL SUBJECTED TO A HARMONIC DISPLACEMENT BOUNDARY CONDITION
Andrew J. Hull 15 Oct. 1992 34 p
(AD-A257733; NUWC-NL-TR-10.165) Avail: CASI HC A03/MF A01

This report develops an approximate closed form solution to a specially orthotropic axisymmetric cylindrical thin shell subjected to a harmonic boundary condition. Modified Love-Timoshenko shell equations forced by a harmonic boundary condition at one end of the shell and grounded by a mechanical spring at the other are used to formulate this boundary value problem. Each modeled shell is subjected to an axial tension, and a steady state approximate solution is then formulated. The solutions derived here are compared to finite element results and to previous models of the thin shell problem. It is shown that the finite element analysis agrees very closely with the equations derived in this study. It is also shown that the earlier models used to analyze specially orthotropic thin shells produce results that do not agree with the model developed here or with the finite element analysis. Shell configurations evaluated include finite length isotropic, finite length specially orthotropic, semi-infinite length specially orthotropic, and damped finite length specially orthotropic. GRA

N93-17779*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TRANSIENT/STRUCTURAL ANALYSIS OF A COMBUSTOR UNDER EXPLOSIVE LOADS
Peyton B. Gregory and Anne D. Holland Dec. 1992 27 p
(RTOP 505-43-31-05)
(NASA-TM-107660; NAS 1.26:107660) Avail: CASI HC A03/MF A01

The 8-Foot High Temperature Tunnel (HTT) at NASA Langley Research Center is a combustion-driven blow-down wind tunnel. A major potential failure mode that was considered during the combustor redesign was the possibility of a deflagration and/or detonation in the combustor. If a main burner flame-out were to occur, then unburned fuel gases could accumulate and, if reignited, an explosion could occur. An analysis has been performed to determine the safe operating limits of the combustor under transient explosive loads. The failure criteria was defined and the failure mechanisms were determined for both peak pressures and differential pressure loadings. An overview of the gas dynamics analysis was given. A finite element model was constructed to evaluate 13 transient load cases. The sensitivity of the structure to the frequency content of the transient loading was assessed. In addition, two closed form dynamic analyses were conducted to verify the finite element analysis. It was determined that the differential pressure load or thrust load was the critical load mechanism and that the nozzle is the weak link in the combustor system. Author

N93-15723# IKO Software Service G.m.b.H., Stuttgart (Germany).
SOME ASPECTS FOR THE APPLICATION OF A HIERARCHIC FAMILY OF HERRMANN MIXED COMPRESSIBLE AND INCOMPRESSIBLE FINITE ELEMENTS
F. Kiss *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 535-540 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15726# Norske Veritas, Oslo.
AN ANALYTICAL AND EXPERIMENTAL STUDY ON THE DESIGN AND VERIFICATION OF CONTAINMENT SUBJECTED TO IMPACT LOADING
Olav Fyrileiv, Magne K. Nygaard, Jens P. Tronskar (Veritas Research A.S., Hovik, Norway), and Stig Waestberg (Veritas Research A.S., Hovik, Norway) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 553-558 (For primary document see N93-15718 05-18)
(Contract ESTEC-8141/89/NL/PH(SC))
Copyright Avail: CASI HC A02/MF A04

N93-15732# Intespace, Toulouse (France).
DEVELOPMENT OF AN INTERACTIVE CODE FOR UPDATING DYNAMIC FINITE ELEMENT MODELS
N. A. Roy, A. Girard, P.-E. Dupuis, and L.-P. Bugeat *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 597-602 Sponsored in part by EEC (For primary document see N93-15718 05-18)
(BRITE Proj. P-2381-5)
Copyright Avail: CASI HC A02/MF A04

N93-15735# LMS International, Leuven (Belgium).
EXCITATION VECTOR CONSIDERATIONS IN MULTIPLE SINUSOIDAL TESTING
D. Otte, J. Debille, W. Bakkers, and H. VanderAuweraer *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 619-623 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-15736# Southampton Univ. (England). Inst. of Sound and Vibration Research.
A STUDY OF HIGH FREQUENCY VIBRATIONS DUE TO PYROTECHNIC SHOCKS IN COUPLED SYSTEMS
D. Lednik and R. J. Pinnington *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 625-630 Sponsored by CNES and Aerospatiale (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15740# Virginia Polytechnic Inst. and State Univ., Blacksburg. Materials Response Group.
MICROMECHANICAL CONCEPTS FOR THE ESTIMATION OF PROPERTY EVOLUTION AND REMAINING LIFE
Ken Reifsnider, Zhanjun Gao, and Rob Swain *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 653-658 (For primary document see N93-15718 05-18)
(Grant AF-AFOSR-0216-89)
Copyright Avail: CASI HC A02/MF A04

N93-15757# Maschinenfabrik Augsburg-Nuernberg A.G., Augsburg (Germany).
TESTING AND CHARACTERISATION OF METALLIC MATERIALS FOR STRUCTURAL ANALYSIS OF HIGH TEMPERATURE COMPONENTS
N. Taylor and P. Agatonovic *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 769-774 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15758# Alenia Spazio S.p.A., Rome (Italy).
RESIDUAL STRESSES IN WELDS AND EFFECT ON CRACK GROWTH PREDICTION
Flavio Bandini *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 775-780 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15760# Alenia Spazio S.p.A., Rome (Italy). Space Antenna Group.
ANALYSIS AND TEST METHODS FOR THE EVALUATION OF DEPLOYMENT SHOCK
William Adam, Alberto Bramante, and Alberto Meschini *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 789-792 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-15762# Southampton Univ. (England). Inst. of Sound and Vibration Research Consultancy Services.
ACOUSTICALLY INDUCED VIBRATION OF PLATFORM MOUNTED EQUIPMENT CONTAINING PRINTED CIRCUIT BOARDS
J. N. Pinder and D. C. G. Eaton (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 801-806 Sponsored by ESA/ESTEC (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15765# DNV Ingemansson A.B., Stockholm (Sweden).
POWER FLOW FINITE ELEMENT ANALYSIS FOR BEAMS AND PLATES

B. Klasen *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 819-823 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-15776# Construcciones Aeronauticas S.A., Madrid (Spain). Div. Espacio.
DESIGN OF JOINTS FOR DAMPED STRUCTURES
P. Luengo *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 901-906 Sponsored by ESA/ESTEC (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15779# Dornier System G.m.b.H., Friedrichshafen (Germany).
STRUCTURE-ACOUSTIC FINITE ELEMENT ANALYSES FOR NOISE REDUCTION INVESTIGATIONS OF LAUNCHER PAYLOAD COMPARTMENT STRUCTURES MADE OF CFRP SANDWICH MATERIAL
M. Faust, G. Schweickert, and F. Strobel *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 925-931 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15781# Sociedad de Investigacion, Estudios y Experimentacion S.A., Madrid (Spain).
MATHEMATICAL MODELLING OF PYROTECHNIC SHOCK IN THE ARIANE 5 VEB STRUCTURE
M. C. Huerta, E. Alarcon (Universidad Politecnica de Madrid, Spain), and S. Gomez-Lera (Universidad Politecnica de Madrid, Spain) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 939-944 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15784# ISTAR, Plaisir (France).
CONTROL OF COMBINED VIBRATIONS AND MULTI-AXIS TEST
G. Catteau and C. Hutin *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 959-961 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-15785*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GROUND TEST VALIDATION FOR PRECISION STRUCTURES
Ben K. Wada, John A. Garba, and James L. Fanson *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 963-967 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-16782*# Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
BEAM, PLATE, AND SHELL FINITE ELEMENTS FOR CSI DESIGN CODE Abstract Only
Duc T. Nguyen *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 153 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16785*# Hawaii Univ., Manoa. Dept. of Civil Engineering.
A VARIATIONAL METHOD FOR FINITE ELEMENT STRESS RECOVERY: APPLICATIONS IN ONE-DIMENSION
H. Ronald Riggs *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 164-168 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16791*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
STABILITY OF GENERALLY STIFFENED ANISOTROPIC NONCIRCULAR CYLINDERS
Nahil Atef Sobh *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 178-179 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16793*# Washington Univ., Saint Louis, MO. Dept. of Civil Engineering.
MODE INTERACTION IN STIFFENED COMPOSITE SHELLS UNDER COMBINED MECHANICAL AND THERMAL LOADINGS
Srinivasan Sridharan *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 183-184 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17294*# Alabama A & M Univ., Huntsville. Dept. of Civil Engineering.
A STUDY OF THE LUTE METERING STRUCTURE
James W. Foreman *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17314*# Community Coll. of Northeast Misssissippi, Senatobia. Division of Mathematics and Science.
PROBLEMS INVOLVING COMBINED LOADING
Lunelle Miller *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography.*

N93-15691*# Lasertechnics, Inc., Albuquerque, NM.
WIDELY TUNABLE GAS LASER FOR REMOTE SENSING Final Technical Report, 1 Aug. 1986 - 31 Oct. 1988
D. E. Rothe Dec. 1988 99 p
(Contract NAS7-970)
(NASA-CR-190869; TR-88-1; NAS 1.26:190869) Avail: CASI HC A05/MF A02

An advanced, highly efficient and reliable Rare-Gas Halide laser was developed. It employs the following: (1) novel prepulse techniques and impedance matching for efficient energy transfer; (2) magnetic switches for high reliability; (3) x-ray preionization for discharge uniformity and beam quality; and (4) an integrated gas flow loop for compactness. When operated as a XeCl laser, the unit produces 2 J per pulse with good beam uniformity. Optical pulse duration is 100 ns. Pulse repetition rate was tested up to 25 Hz. Efficiency is 3 percent. Author

N93-16002# Naval Air Warfare Center, Patuxent River, MD. Aircraft Div.
A NEW GROUND TEST FOR DETERMINING THE RESOLUTION OF PUSHBROOM SENSORS
Michael J. Jenquin 1992 5 p
(AD-A257193) Avail: CASI HC A01/MF A01

A 'pushbroom' sensor is an airborne imaging system which takes a series of one dimensional samples orthogonal to the aircraft line of flight with the second dimension constructed by the forward motion of the platform. With the advent of these highly sophisticated pushbroom reconnaissance sensors, system testing organizations are required to perform a detailed assessment of sensor performance. While in the past, systems have traditionally been tested using static or scrolling stimulation, such techniques have proven to yield only limited data. A ground test capability was developed which supplies highly diverse and repeatable data and which provides a solid statistical base for the determination of system resolution. Working

closely with the 3246 TW/DOR, Eglin Air Force Base, Florida, the exploitable nature of these data has been verified. The data is presented as actually taken from ground tests of a pushbroom sensor performed at Eglin Air Force Base and illustrates the methods and techniques employed to analyze and evaluate the resulting imagery. GRA

N93-16206# Carnegie-Mellon Univ., Pittsburgh, PA. School of Computer Science.
BUILT-UP AREA FEATURE EXTRACTION Final Technical Report, Jul. 1987 - Jun. 1990
Oct. 1991 67 p
(Contract DACA72-87-C-0001)
(AD-A256933; TEC-0016) Avail: CASI HC A04/MF A01

This final technical report describes the overall research progress during a three year period. In July 1987, the Digital Mapping Laboratory at Carnegie Mellon University began work with the U.S. Army Topographic Engineering Center (TEC) to explore the detailed analysis of aerial imagery with particular emphasis on builtup areas containing large numbers of complex man-made structures. During the past three years, research was done in several important areas including scene registration, stereo analysis, shadow analysis, and building detection. Each of these areas addresses an important set of issues toward the development of automated tools for cartographic feature extraction. GRA

N93-16222# Beleidscommissie Remote Sensing, Delft (Netherlands).
FEASIBILITY STUDY ON GLOBAL OPERATIONAL FOREST COVER MONITORING NETWORK FOR FAO USING SATELLITE REMOTE SENSING
G. vanderBurg (National Aerospace Lab., Amsterdam, Netherlands), J. C. Venema (National Aerospace Lab., Amsterdam, Netherlands), J. Spaa (National Aerospace Lab., Amsterdam, Netherlands), D. H. Hoekman (Food and Agriculture Organization of the United Nations, Rome, Italy), J. J. vanderSanden (Food and Agriculture Organization of the United Nations, Rome, Italy), and P. G. Reichert (Food and Agriculture Organization of the United Nations, Rome, Italy) May 1992 105 p
(BCRS Proj. 5.2/TE-0.4)
(BCRS-90-05; ISBN-90-5411-035-X; ETN-93-92850) Avail: CASI HC A06/MF A02

The feasibility of an operational information system, based on satellite remote sensing data, to meet the requirements of the Tropical Forest Action Plan (TFAP), is assessed. Results of the feasibility study are presented. Objectives of the TFAP are summarized. Major (research) programs on the application of remote sensing in forestry are reviewed. The coherence of these programs is indicated; moreover, the essential functions which need to be filled-in, for an operational forest cover monitoring system to be viable, are identified. The present status of the use of optical and radar remote sensing data in forestry is considered. A system development scenario is proposed in terms of short, medium, and long term development plans, along with an indication of the total yearly cost to develop and operate the system. A zero level technical concept of the proposed remote sensing preprocessing facility is given together with an overview of the relevant operational (computer) infrastructure available at the FAO (Food and Agriculture Organization) remote sensing center and which might be suitable for implementation of the first phase of the preprocessing system. Conclusions are summarized and a recommendation for the next step to come to an operational system is given. ESA

N93-16224# Pacific Northwest Lab., Richland, WA.
AN AUTONOMOUS EXPENDABLE DATA COLLECTION DEVICE FOR REMOTE ENVIRONMENTAL SENSING
B. G. DeRoos (Battelle Memorial Inst., Argonne, IL.), J. P. Downing (Battelle Memorial Inst., Seattle.), and K. O. McCoy (Ocean Sensors, Inc., San Diego, CA.) Jun. 1992 17 p Presented at the 1st Thematic Conference on Remote Sensing for Marine and Coastal Environments, New Orleans, LA, 15-17 Jun. 1992
(Contract DE-AC06-76RL-01830)
(DE92-019430; PNL-SA-21223; CONF-9206260-1) Avail: CASI HC A03/MF A01

An Autonomous Expendable Conductivity-Temperature-Depth Profiler (AXCTD) for profiling temperature, conductivity, pressure, and other parameters in remote oceanic regions was developed. The AXCTD is a microcomputer-controlled sensor package that can be deployed by unskilled operators from ships or aircraft. The AXCID records two CID profiles (one during descent and another during ascent) and CTD times series while on the bottom and adrift at the surface. Recorded data are transmitted to an ARGOS satellite with ground-positioning capabilities. Successful sea tests of a prototype AXCI7D, completed in 1989, are reported in this paper. The AXCTD can provide 'sea truth' for remote sensing, perform environmental and military surveillance missions, and acquire time-series and synoptic data for computer models. DOE

N93-16289# Beleidscommissie Remote Sensing, Delft (Netherlands).
USEFULNESS OF THE CAESAR SCANNER FOR OPERATIONAL VEGETATION MAPPING [BRUIKBAARHEID VAN DE CAESAR-SCANNER VOOR OPERATIONELE VEGETATIEKARTERING]
E. H. Kloosterman (Rijkswaterstaat, Delft, Netherlands), H. T. C. vanStokkom (Rijkswaterstaat, Delft, Netherlands), and R. W. L. Jordans (Rijkswaterstaat, Delft, Netherlands) May 1992 71 p In DUTCH
(BCRS Proj. OP-2.7)
(BCRS-91-39; MDLK-RS-R-8938; ISBN-90-5411-020-1; ETN-93-92844)
Avail: CASI HC A04/MF A01

The operational applicability of the CAESAR (CCD (Charge Coupled Device) Airborne Experimental Scanner for Applications in Remote Sensing) for large scale vegetation mapping and monitoring was investigated with a view to nature conservation. The added value of CAESAR as an alternative for stereoscopic interpretation of aerial pictures was not demonstrated. The spectral signature alone is not a diagnostic method to distinguish units for nature vegetation mapping. Unsupervised classification is ecologically not justified. Remote sensing and advanced image processing techniques have to be backed by a good knowledge of the vegetation. Human input and interaction with the processing is a vital part of a successful classification. The spatial resolution of the down looking module is sufficient. The surplus value of the forward looking module was not demonstrated. CAESAR can have a surplus value with respect to aerial photography if ecologically significant, but small spectral differences can be visualized. ESA

N93-16382*# New Mexico Univ., Albuquerque. Dept. of Biology.
WIND EROSION IN SEMIARID LANDSCAPES: PREDICTIVE MODELS AND REMOTE SENSING METHODS FOR THE INFLUENCE OF VEGETATION Semiannual Status Report, 1 Jul. - 31 Dec. 1992
H. Brad Musick, C. Randall Truman, and Steven M. Trujillo 31 Dec. 1992 7 p
(Grant NAG5-1833)
(NASA-CR-191886; NAS 1.26:191886) Avail: CASI HC A02/MF A01

Wind erosion in semi-arid regions is a significant problem for which the sheltering effect of rangeland vegetation is poorly understood. Individual plants may be considered as porous roughness elements which absorb or redistribute the wind's momentum. The saltation threshold is the minimum wind velocity at which soil movement begins. The dependence of the saltation threshold on geometrical parameters of a uniform roughness array was studied in a wind tunnel. Both solid and porous elements were used to determine relationships between canopy structure and the threshold velocity for soil transport. The development of a predictive relation for the influence of vegetation canopy structure on wind erosion of soil is discussed. Author

N93-16504# Army Topographic Engineering Center, Fort Belvoir, VA.
AUTOMATED CLASSIFICATION OF BASIC-LEVEL TERRAIN FEATURES IN DIGITAL ELEVATION MODELS Technical Report, 1 Sep. 1990 - 31 Aug. 1991
Linda H. Graff Aug. 1992 57 p
(AD-A256932; TEC-0013) Avail: CASI HC A04/MF A01

A two-class problem is addressed in automatic terrain classification. One basic-level terrain feature selected for initial delineation is a mount (an aggregation of elevated features including hills, mountains, and ranges), all remaining areas are classified collectively as nonmount. A method was developed to partition digital elevation models (DEMs) into mount and nonmount areas automatically. Then, the developed method is compared to those results obtained by a manual classification of synthetic stereo images produced from the same digital elevation data. The results of this work suggest that it may be possible to replicate the manual identification of mounts in certain physiographic regions. However, the general utility of

the mount/nonmount classification approach appears to be limited by the nature of the regional terrain and by the quality of available digital data.
GRA

N93-16514# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Abteilung Infrarottechnik.
RADIOMETRIC DESIGN OF SENSORS AND QUANTITATIVE EVALUATION OF REMOTE SENSING DATA IN THE OPTICAL SPECTRAL REGION Ph.D. Thesis - Technische Hochschule [RADIOMETRISCHE AUSLEGUNG VON SENSOREN UND QUANTITATIVE AUSWERTUNG VON FERNERKUNDUNGSDATEN IM OPTISCHEN SPEKTRALBEREICH]
Rudolf Richter Dec. 1991 169 p In GERMAN
(DLR-FB-92-01; ETN-93-92399) Avail: CASI HC A08/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A model which can be used as a tool for the radiometric design assessment and optimization of sensors in terrestrial remote sensing, was used to derive an atmospheric correction procedure in the solar reflective region for satellite sensors with a small angular swath width, like LANDSAT Thematic Mapper (TM), MSS, and SPOT. The procedure calculates the reflectance of land surfaces using a fast algorithm with a catalog of atmospheric correction functions. The verification of the model was performed, using data of different sensors in cases where simultaneous ground truth measurements were taken. The accuracy in ground reflectance was 10 to 15 percent while the accuracy in temperature was about 1 C.
ESA

N93-16685*# JJM Systems, Inc., Ivyland, PA.
AN EXPERT SYSTEM SHELL FOR INFERRING VEGETATION CHARACTERISTICS: IMPLEMENTATION OF ADDITIONAL TECHNIQUES (TASK E) Report, Sep. - Oct. 1992
P. Ann Harrison 28 Oct. 1992 52 p
(Contract NAS5-30127; RTOP 462-61-14)
(NASA-CR-190999; NAS 1.26:190999; B921019-U-2R04) Avail: CASI HC A04/MF A01

The NASA VEGetation Workbench (VEG) is a knowledge based system that infers vegetation characteristics from reflectance data. The VEG subgoal PROPORTION.GROUND.COVER has been completed and a number of additional techniques that infer the proportion ground cover of a sample have been implemented. Some techniques operate on sample data at a single wavelength. The techniques previously incorporated in VEG for other subgoals operated on data at a single wavelength so implementing the additional single wavelength techniques required no changes to the structure of VEG. Two techniques which use data at multiple wavelengths to infer proportion ground cover were also implemented. This work involved modifying the structure of VEG so that multiple wavelength techniques could be incorporated. All the new techniques were tested using both the VEG 'Research Mode' and the 'Automatic Mode.' Author

N93-16687*# JJM Systems, Inc., Ivyland, PA.
AN EXPERT SYSTEM SHELL FOR INFERRING VEGETATION CHARACTERISTICS: THE LEARNING SYSTEM (TASKS C AND D) Report, Jul. - Oct. 1992
P. Ann Harrison and Patrick R. Harrison 26 Sep. 1992 147 p
(Contract NAS5-30127; RTOP 462-61-14)
(NASA-CR-191000; NAS 1.26:191000; B921014-U-2R03) Avail: CASI HC A07/MF A02

This report describes the implementation of a learning system that uses a data base of historical cover type reflectance data taken at different solar zenith angles and wavelengths to learn class descriptions of classes of cover types. It has been integrated with the VEG system and requires that the VEG system be loaded to operate. VEG is the NASA VEGetation workbench - an expert system for inferring vegetation characteristics from reflectance data. The learning system provides three basic options. Using option one, the system learns class descriptions of one or more classes. Using option two, the system learns class descriptions of one or more classes and then uses the learned classes to classify an unknown sample. Using option three, the user can test the system's classification performance. The learning system can also be run in an automatic mode. In this mode, options two and three are executed on each sample from an input file. The system was developed using KEE. It is menu driven and contains a sophisticated window and mouse driven interface which guides the user through various computations. Input and output file management and data formatting facilities are also provided. Author

N93-16691*# JJM Systems, Inc., Ivyland, PA.
AN EXPERT SYSTEM SHELL FOR INFERRING VEGETATION CHARACTERISTICS Final Report, Jul. - Oct. 1992
P. Ann Harrison and Patrick R. Harrison 28 Oct. 1992 286 p
(Contract NAS5-30127; RTOP 462-61-14)
(NASA-CR-191207; NAS 1.26:191207; B921020-U-2R00) Avail: CASI HC A13/MF A03

The NASA VEGetation Workbench (VEG) is a knowledge based system that infers vegetation characteristics from reflectance data. The report describes the extensions that have been made to the first generation version of VEG. An interface to a file of unkown cover type data has been constructed. An interface that allows the results of VEG to be written to a file has been implemented. A learning system that learns class descriptions from a data base of historical cover type data and then uses the learned class descriptions to classify an unknown sample has been built. This system has an interface that integrates it into the rest of VEG. The VEG subgoal PROPORTION.GROUND.COVER has been completed and a number of additional techniques that infer the proportion ground cover of a sample have been implemented. Author

N93-16738 Tel-Aviv Univ. (Israel). Dept. of Computer Science.
TEXTURE SEGMENTATION IN AERIAL PHOTOGRAPHS AND SATELLITE IMAGES M.S. Thesis
Erez Sali Oct. 1990 55 p
(ITN-93-85174) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

Texture features have proved to be an important tool in image segmentation and object recognition, as well as in interpretation of images in a variety of applications ranging from medical imaging to remote sensing. Many methods have been suggested to achieve good discrimination between different textural regions. I propose a method that combines a multiresolution-based texture feature with features based on first and second order statistics. These features are calculated for each pixel and its neighbors. A clustering algorithm, based on the generalized Lloyd algorithm, is applied and, finally, an iterative region merging process, based on the phagocytes heuristic, is used to improve the classification of the borders of the regions and to reduce local clustering errors. Examples of the method and the effectiveness of the features are presented, using SPOT images. Author (ISA)

N93-16758*# Texas A&M Univ., College Station. Dept. of Oceanography.
EXPERIMENTAL AND THEORETICAL DETERMINATION OF SEA-STATE BIAS IN RADAR ALTIMETRY Final Report, Jun. 1989 - Dec. 1991
Robert H. Stewart 1991 33 p
(Grant NAGw-1836)
(NASA-CR-191712; NAS 1.26:191712) Avail: CASI HC A03/MF A01

The major unknown error in radar altimetry is due to waves on the sea surface which cause the mean radar-reflecting surface to be displaced from mean sea level. This is the electromagnetic bias. The primary motivation for the project was to understand the causes of the bias so that the error it produces in radar altimetry could be calculated and removed from altimeter measurements made from space by the Topex/Poseidon altimetric satellite. The goals of the project were: (1) observe radar scatter at vertical incidence using a simple radar on a platform for a wide variety of environmental conditions at the same time wind and wave conditions were measured; (2) calculate electromagnetic bias from the radar observations; (3) investigate the limitations of the present theory describing radar scatter at vertical incidence; (4) compare measured electromagnetic bias with bias calculated from theory using measurements of wind and waves made at the time of the radar measurements; and (5) if possible, extend the theory so bias can be calculated for a wider range of environmental conditions. Author

N93-16759*# Oregon State Univ., Corvallis. Coll. of Oceanography.
MODIS ALGORITHM DEVELOPMENT AND DATA VISUALIZATION USING ACTS Final Technical Report
Mark R. Abbott 2 Oct. 1992 6 p

(Grant NAGw-2339)
(NASA-CR-191940; NAS 1.26:191940) Avail: CASI HC A02/MF A01

The study of the Earth as a system will require the merger of scientific and data resources on a much larger scale than has been done in the past. New methods of scientific research, particularly in the development of geographically dispersed, interdisciplinary teams, are necessary if we are to understand the complexity of the Earth system. Even the planned satellite missions themselves, such as the Earth Observing System, will require much more interaction between researchers and engineers if they are to produce scientifically useful data products. A key component in these activities is the development of flexible, high bandwidth data networks that can be used to move large amounts of data as well as allow researchers to communicate in new ways, such as through video. The capabilities of the Advanced Communications Technology Satellite (ACTS) will allow the development of such networks. The Pathfinder global AVHRR data set and the upcoming SeaWiFS Earthprobe mission would serve as a testbed in which to develop the tools to share data and information among geographically distributed researchers. Our goal is to develop a 'Distributed Research Environment' that can be used as a model for scientific collaboration in the EOS era. The challenge is to unite the advances in telecommunications with the parallel advances in computing and networking. Author

N93-17053# Beleidscommissie Remote Sensing, Delft (Netherlands).
LEAF RESEARCH Final Report
A. Rosema (Environmental Analysis and Remote Sensing, Delft, Netherlands), J. Schroote (Wageningen Agricultural Univ., Netherlands), J. F. H. Snel (Wageningen Agricultural Univ., Netherlands), W. Verhoef (National Aerospace Lab., Amsterdam, Netherlands), and L. Mertens (Nedinsco B.V., Venlo, Netherlands) Apr. 1992 61 p
(BCRS Proj. AO-4.6)
(BCRS-91-16; ISBN-90-5411-041-4; ETN-93-92840) Avail: CASI HC A04/MF A01

The Laser Environmental Active Fluorosensor (LEAF) project is described. This project consists of two parts: instrument development and application research. The LEAF instrument is dedicated to the fast and user friendly collection of fluorescence remote sensing data in four spectral bands. The research part of the project consists of plant physiological research and remote sensing research. Techniques of plant fluorescence measurement and experiments carried out in the laboratory are examined. Modeling of fluorescence light-canopy interaction, a sensitivity study, is considered. A method to separate chlorophyll fluorescence yield and canopy structure effects is presented. Background information is given. ESA

N93-17397# Winand Staring Centre, Wageningen (Netherlands). Inst. voor Onderzoek van het Landelijk Gebied.
VALIDATION OF SIMULATED EVAPORATION REDUCTIONS USING REMOTE SENSING IN MANDER (NETHERLANDS) [VALIDATIE VAN GESIMULEERDE VERDAMPINGSREDUCTIES MET REMOTE SENSING IN MANDER]
A. A. Hooijer and M. J. Verbeek 1991 81 p In DUTCH
(Rept-131; ETN-92-92540) Copyright Avail: CASI HC A05/MF A01

Simulated evaporation reductions from hydrological models which simulate the water motions in the the unsaturated part of the soil, were validated using remote sensing in the research domain Mander in the province Overyssel. The geological map combined with data concerning water table and meteorology were used to calculate the evaporation reductions with the hydrological model MUST. Thermal video camera pictures were also used to deduce evaporation reductions. ESA

N93-17588# Technische Univ., Delft (Netherlands). Vakgroep Fysische, Meetkundige en Ruimte Geodesie.
LEAST SQUARES HARMONIC ANALYSIS APPLIED TO PHENOMENA RELATED TO EARTH ROTATION Thesis
Sonja vandeRoemer Jun. 1991 195 p Sponsored by EEC Erasmus Fund
(ETN-92-92532) Avail: CASI HC A09/MF A03

The variable rotation of the Earth is addressed. Several time series that are characteristic of solar activity (number and area of the sunspots, activity in the corona), atmosphere (angular momentum, geomagnetic index), or of the Earth rotation, are analyzed. The spectra of these time series, especially the spectrum around fluctuations with a period of 50, 120 and 800 days, are computed with the Least Squares Harmonic Analysis (LSHA) method and compared with each other. The LSHA method provides for computing the spectrum of a time series with a least squares estimation, and for indicating the statistic (in)significance of the periodicities by means of a significance level in the spectrum. ESA

N93-17726# Phillips Lab., Hanscom AFB, MA.
THE DIVISION OF A CIRCLE OR SPHERICAL SURFACE INTO EQUAL-AREA CELLS OR PIXELS
Irving I. Gringorten and Penelope J. Yepez 30 Jun. 1992 12 p
(AD-A257770; AD-E201257; PL-TR-92-2167; IP-343; XC-PL/HANSCOM)
Avail: CASI HC A03/MF A01

The need to partition a circular area into many equally sized cells or pixels had arisen in several problems dealing with mapping phenomena within a circle. A radar picture of the horizontal extent of precipitation surrounding a station is usually of the circular area surrounding the station within approximately 192 kilometers (120 miles) radius. The radar picture is conveniently analyzed by the presence or absence of a radar echo in each small cell within the circle. Since the spherical surface of the earth can be portrayed on an equal-area map, the proposed method of dividing the circle into equally sized pixels is especially applicable for detailed mapping of a spherical surface such as the northern hemisphere. GRA

N93-17728# New Mexico State Univ., Las Cruces. Dept. of Mathematical Sciences.
DIFFERENTIAL CARTOGRAPHY Report No. 4
J. D. Zund 13 Jul. 1992 16 p
(Contract F19628-89-K-0044)
(AD-A257772; AD-E201248; PL-TR-92-2181) Avail: CASI HC A03/MF A01

The various properties of conformal projections of a sphere and a surface of revolution are derived by using the notions of differential cartography. It is shown that familiar properties of the Mercator projection may be carried over from a sphere to an arbitrary surface of revolution. GRA

N93-17739# Observatoire de Paris (France).
IERS STANDARDS FOR 1992 Technical Note No. 13
Dennis D. McCarthy Jul. 1992 161 p
(AD-A257973) Avail: CASI HC A08/MF A02

This series of publications gives technical information related to the IERS activities, e.g. reference frames, excitation of the Earth rotation, computational or analysis aspects, models, etc. It also contains the description and results of the analyses performed by the IERS Analysis Centres for the Annual Report global analyses. GRA

N93-17755# Naval Postgraduate School, Monterey, CA.
COMPARISON OF AREAL EXTENT OF SNOW AS DETERMINED BY AVHRR AND SSM/I SATELLITE IMAGERY M.S. Thesis
Robert W. Maxson Sep. 1992 106 p
(AD-A258054) Avail: CASI HC A06/MF A02

Advanced Very High Radiometric (AVHRR) and Special Sensor Microwave Imager (SSM/I) imagery are compared to determine the areal extent of snow. A multi-spectral AVHRR algorithm, utilizing channels 1 (0.63 microns), 2 (0.87 microns), 3 (3.7 microns), and 4 (11.0 microns), creates a synthetic image that classified land, snow, water and clouds. The classified images created by this algorithm serve as a baseline for a second algorithm that examines spatially and temporally matched SSM/I imagery. The SSM/I separation algorithm uses the 85 GHz horizontally polarized channel as well as the 37 GHz horizontally and vertically polarized channels. The synthetic image created by this algorithm classifies land, snow and water. Both separation algorithms use empirically derived separation thresholds obtained from bi-spectral scatter plots. Separation is made at a given pixel location based on the radiative identity assigned to that location from various wavelength combinations. The AVHRR data provides high resolution, daytime images of the snow pack but is completely dependent on the absence of clouds to view this ground based feature. The SSM/I data gives lower resolution imagery of the snow during daylight or night time satellite passes and is not affected by the presence of nonprecipitating clouds. A total of 12 sub scenes are analyzed using both data sets and general agreement of the two sets of imagery is established. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N93-15669# Oregon Inst. of Tech., Klamath Falls. Geo-Heat Center.
DATA ACQUISITION FOR LOW-TEMPERATURE GEOTHERMAL WELL TESTS AND LONG-TERM MONITORING
P. J. Lienau Sep. 1992 44 p
(Contract DE-FG07-90ID-13040)
(DE93-000387; DOE/ID-13040/T11) Avail: CASI HC A03/MF A01

Groundwater monitoring is an essential part of the development of a low-temperature geothermal field for production and injection wells. State water resource and environmental departments are requiring both geothermal well testing and long-term monitoring as a part of the permitting process for geothermal developments. This report covers water-level measurement methods, instruments used for well testing, geochemical sampling, examples of data acquisition and regulatory mandates on groundwater monitoring. DOE

N93-15810# California Univ., Berkeley. Lawrence Berkeley Lab.
CASE STUDIES OF THERMAL ENERGY STORAGE (TES) SYSTEMS: EVALUATION AND VERIFICATION OF SYSTEM PERFORMANCE
H. Akbari and O. Sezgen Jan. 1992 55 p
(Contract DE-AC03-76SF-00098)
(DE93-001572; LBL-30852) Avail: CASI HC A04/MF A01

We have developed two case studies to review and analyze energy performance of thermal energy storage CMS systems in commercial buildings. Our case studies considered two partial ice storage systems in Northern California. For each case, we compiled historical data on TES design, installation, and operation. This information was further enhanced by data obtained through interviews with the building owners and operators. The performance and historical data of the TES systems and their components were grouped into issues related to design, installation, operation, and maintenance of the systems. Our analysis indicated the following: (1) almost all problems related to the operation of TES and non-TES systems could be traced back to the design of the system; and (2) the identified problems were not unique to the TES systems. There were as many original problems with 'conventional' HVAC systems and components as with TES systems. Judging from the problems related to non-TES components identified in these two case studies, it is reasonable to conclude that conventional systems have as many problems as TES systems, but a failure, in a TES system may have a more dramatic impact on thermal comfort and electricity charges. The objective of the designers of the TES systems in the case-study buildings was to design just-the-right-size systems so that both the initial investment and operating costs would be minimized. Given such criteria, a system is typically designed only for normal and steady-state operating conditions-which often precludes due consideration to factors such as maintenance, growth in the needed capacity, ease of the operation, and modularity of the systems. Therefore, it is not surprising to find that these systems, at least initially, did not perform to the design intent and expectation and that they had to go through extended periods of trouble-shooting. DOE

N93-15839# Sandia National Labs., Albuquerque, NM.
WIND LOAD DESIGN METHODS FOR GROUND-BASED HELIOSTATS AND PARABOLIC DISH COLLECTORS
J. A. Peterka and R. G. Derickson Sep. 1992 80 p
(Contract DE-AC04-76DP-00789)
(DE93-002737; SAND-92-7009) Avail: CASI HC A05/MF A01

The purpose of this design method is to define wind loads on flat heliostat and parabolic dish collectors in a simplified form. Wind loads are defined for both mean and peak loads accounting for the protective influence of upwind collectors, wind protective fences, or other wind-blockage elements. The method used to define wind loads was to generalize wind load data obtained during tests on model collectors, heliostats or parabolic dishes, placed in a modeled atmospheric wind in a boundary-layer wind-tunnel at Colorado State University. For both heliostats and parabolic dishes, loads are reported for solitary collectors and for collectors as elements of a field. All collectors were solid with negligible porosity; thus the effects of porosity in the collectors is not addressed. DOE

N93-15850# Midwest Research Inst., Golden, CO.
SOLAR THERMAL ELECTRIC AND BIOMASS POWER: PROGRAM OVERVIEWS, FISCAL YEARS 1990-1991
Jun. 1992 23 p
(Contract DE-AC02-83CH-10093)
(DE92-010582; DOE/CH-10093/148) Avail: Issuing Activity

This document highlights progress made in the U.S. Department of Energy's Solar Thermal Electric and Biomass Power Programs during FY 1990-FY 1991. A broad outline is offered of program goals, overview of the technologies, performance of existing solar plants, and prospects for future development of the technology. DOE

N93-15899# Argonne National Lab., IL.
PROCEEDINGS OF THE SIXTEENTH DOE SOLAR PHOTOCHEMISTRY RESEARCH CONFERENCE
1992 246 p Presented at the 16th DOE Solar Photochemistry Research Conference, Delavan, WI, 31 May - 4 Jun. 1992
(Contract W-31-109-eng-38)
(DE93-001760; CONF-9205243) Avail: CASI HC A11/MF A03

The conference brings together contractors and grantees engaged in research on photochemical energy conversion to foster cooperation, collaboration, and exchange of current research ideas. The meeting provides an opportunity for cross-fertilization and synergistic interaction among investigators who share common long-range goals of producing low-cost fuels and chemicals or electricity by photochemical conversion of solar energy. The program this year encompassed the topical areas of transition metal photochemistry and photophysics, electron transfer, photosynthesis, photoelectrochemistry, organic photochemistry, and photoredox chemistry in heterogeneous environments. This volume contains the agenda for the meeting, abstracts of 30 formal presentations and 54 posters, a record of question/answer discussions, as well as the participant list and an author index. DOE

N93-15903# New Energy and Industrial Technology Development Organization, Tokyo (Japan).
GEOTHERMAL ENERGY SURVEY AND TECHNOLOGY Annual Report, FY 1990
1992 55 p
(DE93-716356; NEDO-OS-9103) Avail: CASI HC A04/MF A01

This is an FY-1990 Annual Report on 'geothermal energy survey and technology' by New Energy and Industrial Technology Development Organization (NEDO). First, concerning geothermal resources exploration project in which surveys have been executed throughout Japan since 1980, outlines of surveys in 1990 and objectives for FY-1992 are summarized. As for surveys for promoting development of geothermal energy, surveys in 8 areas conducted for three years from 1988 to 1990 as well as future plans are also described. Then, the verification investigation for geothermal survey technologies, which has been executed since 1980 for the purpose of establishing geothermal survey technologies to promote the development of geothermal resources in Japan, is introduced with outlines of surveys in 1990 and objectives for FY-1992. Furthermore, development conditions of power generation technologies utilizing geothermal energy such as binary-cycle power generation and hot dry rock power generation are described. DOE

N93-15919# California Univ., Berkeley. Lawrence Berkeley Lab.
SOLID-POLYMER-ELECTROLYTE FUEL CELLS Ph.D. Thesis
T. F. Fuller Jul. 1992 248 p
(Contract DE-AC03-76SF-00098)
(DE92-041204; LBL-32577) Avail: CASI HC A11/MF A03

A transport model for polymer electrolytes is presented, based on concentrated solution theory and irreversible thermodynamics. Thermodynamic driving forces are developed, transport properties are identified and experiments devised. Transport number of water in Nafion 117 membrane is determined using a concentration cell. It is 1.4 for a membrane equilibrated with saturated water vapor at 25 C, decreases slowly as the membrane is dehydrated, and falls sharply toward zero as the water content approaches zero. The relation between transference

number, transport number, and electroosmotic drag coefficient is presented, and their relevance to water-management is discussed. A mathematical model of transport in a solid-polymer-electrolyte fuel cell is presented. A two-dimensional membrane-electrode assembly is considered. Water management, thermal management, and utilization of fuel are examined in detail. The membrane separators of these fuel cells require sorbed water to maintain conductivity; therefore it is necessary to manage the water content in membranes to ensure efficient operation. Water and thermal management are interrelated. Rate of heat removal is shown to be a critical parameter in the operation of these fuel cells. Current-voltage curves are presented for operation on air and reformed methanol. Equations for convective diffusion to a rotating disk are solved numerically for a consolute point between the bulk concentration and the surface. A singular-perturbation expansion is presented for the condition where the bulk concentration is nearly equal to the consolute-point composition. Results are compared to Levich's solution and analysis. DOE

N93-15935# Gilbert/Commonwealth, Reading, PA.
DOE HEADQUARTERS MHD/FUEL CELL SUPPORT CONTRACT
J. H. Hirschenhofer and R. W. Owens 1992 10 p Presented at the US Department of Energy Contractors Review Meeting on Fuel Cells, Morgantown, WV, 14-15 Jul. 1992
(Contract DE-AC01-88FE-61684)
(DE92-040257; DOE/FE-61684/92/C0054; CONF-920748-16) Avail: CASI HC A02/MF A01

The objective is to acquire scientific engineering and program technical support, for the development of strategies and plans for advanced energy conversion systems including phosphoric acid, molten carbonate, solid oxide, and other advanced fuel cell concepts. Gilbert/Commonwealth's Advanced Technologies Services Group is responsible for performing task assignments for this support contract. This group's consulting and process capabilities are described. Some typical task orders are listed. Some examples of reports of the technical results from this support contract are given. Continuing work and future plans are discussed. DOE

N93-15952# New Energy and Industrial Technology Development Organization, Tokyo (Japan).
ELEVENTH ANNUAL CONFERENCE ON ALCOHOL AND BIOMASS ENERGY TECHNOLOGIES
Oct. 1991 96 p
(DE93-716346; NEDO-OS-9106) Avail: CASI HC A05/MF A01

NEDO is undertaking a number of alcohol and biomass energy technology projects aiming at developing technology for bacterial production of fuel alcohol directly from currently unutilized resources such as agricultural and forestry wastes. This book reports the eleventh annual conference and consists of two parts. Part one describes outlines of these projects classified into three groups. In part two, achievements of these projects are reported in detail. For the development of fuel alcohol production technology using bacteria, searching for and breeding superior bacteria were achieved, and the optimum design of a total production system including a fermenter and peripheral processes was studied. Next, for the development of a high-efficiency membrane complex methane production unit from sewage and industrial waste water, membrane modules, a new type bioreactor, and an instrumentation and control system were investigated, leading to test production with pilot plants. Finally, for demonstration tests for converting oil-fired power stations to methanol, developmental studies on stationary diesel power generation and others were carried out. DOE

N93-16034# California Univ., Berkeley. Lawrence Berkeley Lab.
ENERGY CONVERSION AND STORAGE PROGRAM
E. J. Cairns Mar. 1992 36 p
(Contract DE-AC03-76SF-00098)
(DE93-001545; LBL-30866) Avail: CASI HC A03/MF A01

The Energy Conversion and Storage Program applies chemistry and materials science principles to solve problems in: (1) production of new synthetic fuels; (2) development of high-performance rechargeable batteries and fuel cells; (3) development of advanced thermochemical processes for energy conversion; (4) characterization of complex chemical processes; and (5) application of novel materials for energy conversion and transmission. Projects focus on transport-process principles, chemical kinetics, thermodynamics, separation processes, organic and physical chemistry, novel materials, and advanced methods of analysis. Electrochemistry research aims to develop advanced power systems for electric vehicle and stationary energy storage applications. Topics include identification of new electrochemical couples for advanced rechargeable batteries, improvements in battery and fuel-cell materials, and the establishment of engineering principles applicable to electrochemical energy storage and conversion. Chemical Applications research includes topics such as separations, catalysis, fuels, and chemical analyses. Included in this program area are projects to develop improved, energy-efficient methods for processing waste streams from synfuel plants and coal gasifiers. Other research projects seek to identify and characterize the constituents of liquid fuel-system streams and to devise energy-efficient means for their separation. Materials Applications research includes the evaluation of the properties of advanced materials, as well as the development of novel preparation techniques. For example, the use of advanced techniques, such as sputtering and laser ablation, are being used to produce high-temperature superconducting films. DOE

N93-16046# Lawrence Livermore National Lab., CA.
ENERGY TECHNOLOGY EVALUATION REPORT: ENERGY SECURITY
R. Koopman, A. Lamont, and R. Schock Sep. 1992 72 p
(Contract W-7405-eng-48)
(DE93-001830; UCRL-ID-111970) Avail: CASI HC A04/MF A01

Energy security was identified in the National Energy Strategy (NES) as a major issue for the Department of Energy (DOE). As part of a process designed by the DOE to identify technologies important to implementing the NES, an expert working group was convened to consider which technologies can best contribute to reducing the nation's economic vulnerability to future disruptions of world oil supplies, the working definition of energy security. Other working groups were established to deal with economic growth, environmental quality, and technical foundations. Energy Security working group members were chosen to represent as broad a spectrum of energy supply and end-use technologies as possible and were selected for their established reputations as experienced experts with an ability to be objective. The time available for this evaluation was very short. The group evaluated technologies using criteria taken from the NES which can be summarized for energy security as follows: diversifying sources of world oil supply so as to decrease the increasing monopoly status of the Persian Gulf region; reducing the importance of oil use in the US economy to diminish the impact of future disruptions in oil supply; and increasing the preparedness of the US to deal with oil supply disruptions by having alternatives available at a known price. The result of the first phase of the evaluation process was the identification of technology groups determined to be clearly important for reducing US vulnerability to oil supply disruptions. The important technologies were mostly within the high leverage areas of oil and gas supply and transportation demand but also included hydrogen utilization, biomass, diversion resistant nuclear power, and substitute industrial feedstocks. DOE

N93-16084# Westinghouse Electric Corp., Pittsburgh, PA. Nuclear and Advanced Technology Div.
GAS COOLED FUEL CELL SYSTEMS TECHNOLOGY DEVELOPMENT
Final Report
M. H. Canton, W. A. Chepanoske, J. M. Feret, L. L. France, N. L. Haines, C. F. Heberling, R. R. Holman, J. L. Kelly, and E. L. Kochka et al Mar. 1992 193 p Prepared in cooperation with Energy Research Corp., Danbury, CT
(Contract DE-AC21-82MC-24223)
(DE92-001298; DOE/MC-24223/3103) Avail: CASI HC A09/MF A03

The development is reported of a Phosphoric Acid Fuel Cell (PAFC) for electric utility or industrial power plant applications. Results of this effort include: (1) development of a baseline rolled electrode technology; (2) advancement of fuel cell technology through improvements in the areas of acid management, catalyst selection, electrode and plate materials and processes, components designs, and quality assurance programs; (3) demonstration of improved fuel cell and stack performance and endurance; (4) successful scaleup of cell and stack design features into fun height 100 kill stacks; and (5) demonstration of combining stacks into a 400 kill module that will be the building block for power plants, including the development of testing facilities and operating procedures applicable to plant operations. DOE

N93-16087# Arizona State Univ., Tempe.
OPEN-CYCLE ABSORPTION SOLAR COOLING: NATURAL CONVECTION HEAT AND MASS TRANSFER FROM FALLING FILMS IN VERTICAL CHANNELS
G. A. Buck and B. D. Wood Jun. 1992 315 p
(Contract DE-FG03-86SF-16345)
(DE92-040999; DOE/SF-16345/5) Avail: CASI HC A14/MF A03

In the design of solar collector/regenerators for use in open cycle absorption refrigeration (OCAR) units, the problem of predicting evaporation rates and solution temperatures is of paramount importance in determining overall cycle performance. The governing equations for natural convection flow in a vertical channel bounded by a heated falling film (simulating a glazed collector/regenerator) were solved using several different finite difference techniques. The numerical results were validated against existing experimental and numerical results for simplified boundary conditions. The appropriate nondimensionalization for the falling film boundary condition was established, ostensibly for the first time, and a parametric study for an air-water vapor mixture has been presented. Curve fits to the numerical results were determined for engineering design applications. To further confirm the validity of the numerical solutions, an experimental apparatus was constructed using electric resistance heat to simulate the constant heat flux of the solar source. Water was introduced at the top of this heated vertical surface at various flow rates and under various supplied heat fluxes, and a natural convection channel flow generated between the heated falling film and a parallel, plexiglas surface. Film temperatures and moist air velocity profiles were measured at various streamwise (vertical) locations for comparison with the numerical results. DOE

N93-16134# Midwest Research Inst., Golden, CO.
INDUSTRIAL INNOVATIONS FOR TOMORROW: ADVANCES IN INDUSTRIAL ENERGY-EFFICIENCY TECHNOLOGIES
Aug. 1992 2 p Prepared in cooperation with Energetics, Inc.
(Contract DE-AC02-83CH-10093)
(DE92-001230; DOE/CH-10093/138) Avail: CASI HC A01/MF A01

Engineering Resources, Inc., is developing and testing a biological process for converting the waste gases into acetic acid. The process can operate at the atmospheric temperature and pressure of the carbon black waste gas stream and can selectively utilize the gas components to produce acetic acid. The technology should also be applicable to waste gases from the production of coke (used to make steel) and other industries as well. DOE

N93-16135# Midwest Research Inst., Golden, CO.
INDUSTRIAL INNOVATIONS FOR TOMORROW: ADVANCES IN INDUSTRIAL ENERGY-EFFICIENCY TECHNOLOGIES
Jul. 1992 2 p Prepared in cooperation with Energetics, Inc.
(Contract DE-AC02-83CH-10093)
(DE92-001231; DOE/CH-10093/139) Avail: CASI HC A01/MF A01

To use slurries efficiently in a process, engineers must be able to determine the particle size distribution. A new particle size sensor is under development, based on ultrasonic spectroscopy and mathematical modeling. A field test prototype is being installed at a pilot facility for manufacturing pigments. The mathematical model has also been modified. The sensor is expected to enhance process control in the chemicals industry. DOE

N93-16249# Los Alamos National Lab., NM.
CHARACTERIZATION OF POLYMER ELECTROLYTES FOR FUEL CELL APPLICATIONS
T. A. Zawodzinski, Jr., T. E. Springer, F. Uribe, and S. Gottesfeld 1992 38 p Presented at the 1992 Satellite Meeting on Polyme Ionics, Goeteborg (Sweden), 10-26 Aug. 1992
(Contract W-7405-eng-36)
(DE92-040330; LA-UR-92-2584; CONF-9208133-1) Avail: CASI HC A03/MF A01

Work is reviewed on polymer electrolyte fuel cells emphasizing membrane transport issues. Transport parameters measured at 30 C for several available perfluorosulfonic acid membranes are compared. The water sorption characteristics, diffusion coefficient of water, electroosmotic drag, and pretonic conductivity were determined for Nafion (tmk) 117, Membrane C, and Dow XUS 13204.10 Developmental Fuel Cell Membrane. The diffusion coefficient and conductivity of each of these membranes were determined as functions of membrane water content. Data on water sorption and conductivity are reported for an experimental membrane which is a modified form of Nafion. Contact angle measurements indicate that the surface of a perfluorosulfonic acid membrane exposed to water vapor is quite hydrophobic, even in the presence of saturated water vapor. Modeling of water distribution in PEFC's based on the uptake and transport data shows that membrane thickness contributes in a nonlinear fashion to performance in PEM fuel cells. Finally, some work currently underway is discussed. DOE

N93-16374*# Physitron, Inc., Huntsville, AL.
LDEF SOLAR CELL RADIATION EFFECTS ANALYSIS Final Report, 20 May 1992 - 20 Jan. 1993
Carol J. Rives, Joseph L. Azarewicz, and Lloyd Massengill 20 Jan. 1993 19 p
(NASA Order H-13099-D; RTOP 506-41-11)
(NASA-CR-191776; NAS 1.26:191776; PHY-93R004) Avail: CASI HC A03/MF A01

Because of the extended time that the Long Duration Exposure Facility (LDEF) mission stayed in space, the solar cells on the satellite experienced greater environments than originally planned. The cells showed an overall degradation in performance that is due to the combined effects of the various space environments. The purpose of this analysis is to calculate the effect of the accumulated radiation on the solar cells, thereby helping Marshall Space Flight Center (MSFC) to unravel the relative power degradation from the different environments. Author

N93-16448# Georgia Inst. of Tech., Atlanta.
HIGH EFFICIENCY CADMIUM TELLURIDE AND ZINC TELLURIDE BASED THIN-FILM SOLAR CELLS
A. Rohatgi, R. Sudharsanan, S. A. Ringel, and H. C. Chou Oct. 1992 108 p Prepared for Midwest Research Inst., Golden, CO
(Contract DE-AC02-83CH-10093)
(DE92-016403; NREL/TP-451-4999) Avail: CASI HC A06/MF A02

Work is described which improves the understanding of CdTe and ZnTe alloys by growing and characterizing these films along with cell fabrication. The objective was to develop wide bandgap (1.6 to 1.8 eV) material for the top cell, along with compatible window material and transparent ohmic contacts, so that a cascade cell design can be optimized. Front-wall solar cells were fabricated with a glass/SnO2/CdS window, where the CdS film is thin to maximize transmission and current. Wide bandgap absorber films (E sub g = 1.75 eV) were grown by molecular beam epitaxy (MBE) and metal-organic chemical vapor deposition (MOCVD) techniques, which provided excellent control for tailoring the film composition and properties. CdZnTe films were grown by both MBE and MOCVD. All the as-grown films were characterized by several techniques (surface photovoltage spectroscopy, Auger electron spectroscopy (AES), and x ray photoelectron spectroscopy (XPS)) for composition, bulk uniformity, thickness, and film and interface quality. Front-wall-type solar cells were fabricated in collaboration with Ametek Materials Research Laboratory using CdTe and CdZnTe polycrystalline absorber films. The effects of processing on ternary film were studied by AES and XPS coupled with capacitance voltage and current voltage measurements as a function of temperature. Bias-dependent spectral response and electrical measurements were used to test some models in order to identify and quantify dominant loss mechanisms. DOE

N93-16516# Solar Cells, Inc., Toledo, OH.
FABRICATION OF STABLE, LARGE-AREA, THIN-FILM CdTe PHOTOVOLTAIC MODULES
J. F. Nolan and P. V. Meyers Sep. 1992 17 p Prepared for Midwest Research Inst., Golden, CO
(Contract DE-AC02-83CH-10093)
(DE92-016445; NREL/TP-413-5011) Avail: CASI HC A03/MF A01

Solar Cells, Inc. (SCI) has a program to produce 60 cm X 120 cm solar modules based on CdTe films. The method of choice for semiconductor deposition is condensation from high temperature vapor's. Early work focussed on Close Spaced Sublimation and Chemical Vapor Deposition using elemental sources, but later equipment designs no longer strictly conform to either category. Small area efficiency has been confirmed by NREL at 9.3 percent on a 0.22 sq cm device (825 mV Voc, 18.2 mA/sq cm Jsc, and 0.62 FF) deposited on a 100 sq cm substrate. On 8 cell, 64 sq cm submodules, the best result to date is 7.3 percent (5.9 V Voc, 130

mA Isc, and 0.61 FF). CdS, CdTe, and ZnTe films have been deposited onto 60 cm X 120 cm substrates - single cells produced from this material have exceeded 8 percent efficiency, 64 sq cm submodules have exceeded 5 percent. Module efficiency is limited by mechanical defects - mostly shunts - associated with processing after deposition of the semiconductor layer's. Present best result is 1.4 percent total area efficiency. In anticipation of more advanced designs, CdTe films have also been deposited from apparatus employing elemental sources. This project is in an early stage and has produced only rudimentary results. A pro-active Safety, Health, Environmental, and Disposal Program has been developed. Results to date indicate that both employees and the environment have been protected against overexposure to hazards including toxic chemicals. DOE

N93-16553# Sandia National Labs., Albuquerque, NM.
AN OVERVIEW OF CURRENT ACTIVITIES AT THE NATIONAL SOLAR THERMAL TEST FACILITY
C. P. Cameron and P. C. Klimas 1992 13 p Presented at the 6th International Symposium on Solar Thermal Concentrating Technologies, Mojacar, Spain, 28 Sep. - 2 Oct. 1992
(Contract DE-AC04-76DP-00789)
(DE92-041160; SAND-92-1031C; CONF-920938-1) Avail: CASI HC A03/MF A01

This paper is a description of the United States Department of Energy's National Solar Thermal Test Facility, highlighting current test programs. In the central receiver area, research underway supports commercialization of molten nitrate salt technology, including receivers, thermal energy transport, and corrosion experiments. Concentrator research includes large-area, glass-metal heliostats and stretched-membrane heliostats and dishes. Test activities in support of dish-Stirling systems with reflux receivers are described. Research on parabolic troughs includes characterization of several receiver configurations. Other test facility activities include solar detoxification experiments, design assistance testing of commercially-available solar hardware, and non-DOE-funded work, including thermal exposure tests and testing of volumetric and PV central receiver concepts. DOE

N93-16617*# Sverdrup Technology, Inc., Brook Park, OH.
EXPERIMENTAL DETERMINATION OF IN SITU UTILIZATION OF LUNAR REGOLITH FOR THERMAL ENERGY STORAGE Final Report
Scott W. Richter Jan. 1993 8 p
(Contract NAS3-25266; RTOP 506-41-31)
(NASA-CR-191050; E-7515; NAS 1.26:191050) Avail: CASI HC A02/MF A01

A Lunar Thermal Energy from Regolith (LUTHER) experiment has been designed and fabricated at the NASA Lewis Research Center to determine the feasibility of using lunar soil as thermal energy storage media. The experimental apparatus includes an alumina ceramic canister (25.4 cm diameter by 45.7 cm length) which contains simulated lunar regolith, a heater (either radiative or conductive), 9 heat shields, a heat transfer cold jacket, and 19 type B platinum rhodium thermocouples. The simulated lunar regolith is a basalt, mined and processed by the University of Minnesota, that closely resembles the lunar basalt returned to earth by the Apollo missions. The experiment will test the effects of vacuum, particle size, and density on the thermophysical properties of the regolith. The properties include melt temperature (range), specific heat, thermal conductivity, and latent heat of storage. Two separate tests, using two different heaters, will be performed to study the effect of heating the system using radiative and conductive heat transfer. The physical characteristics of the melt pattern, material compatibility of the molten regolith, and the volatile gas emission will be investigated by heating a portion of the lunar regolith to its melting temperature (1435 K) in a 10(exp -4) pascal vacuum chamber, equipped with a gas spectrum analyzer. A finite differencing SINDA model was developed at NASA Lewis Research Center to predict the performance of the LUTHER experiment. The analytical results of the code will be compared with the experimental data generated by the LUTHER experiment. The code will predict the effects of vacuum, particle size, and density has on the heat transfer to the simulated regolith. Author

N93-16653# Argonne National Lab., IL. Environmental Assessment and Information Sciences Div.
C&RE-SLC: DATABASE FOR CONSERVATION AND RENEWABLE ENERGY ACTIVITIES
J. D. Cavallo, M. M. Tompkins, and A. G. Fisher Aug. 1992 11 p
(Contract W-31-109-eng-38)
(DE93-001929; ANL/EAIS/TM-76) Avail: CASI HC A03/MF A01

The Western Area Power Administration (Western) requires all its long-term power customers to implement programs that promote the conservation of electric energy or facilitate the use of renewable energy resources. The hope is that these measures could significantly reduce the amount of environmental damage associated with electricity production. As part of preparing the environmental impact statement for Western's Electric Power Marketing Program, Argonne National Laboratory constructed a database of the conservation and renewable energy activities in which Western's Salt Lake City customers are involved. The database provides information on types of conservation and renewable energy activities and allows for comparisons of activities being conducted at different utilities in the Salt Lake City region. Sorting the database allows Western's Salt Lake City customers to be classified so the various activities offered by different classes of utilities can be identified; for example, comparisons can be made between municipal utilities and cooperatives or between large and small customers. The information included in the database was collected from customer planning documents in the files of Western's Salt Lake City office. DOE

N93-16655# Sandia National Labs., Albuquerque, NM.
DEVELOPMENT OF A COMMERCIAL PHOTOVOLTAIC CONCENTRATOR MODULE
S. T. Saifee and G. Hutchison Sep. 1992 73 p Prepared in cooperation with Solar Kinetics, Inc., Dallas, TX
(Contract DE-AC04-76DP-00789)
(DE93-002594; SAND-92-7001) Avail: CASI HC A04/MF A01

The objective of this work was to develop the design and prototype of a commercial high-concentration photovoltaic (PV) module. The design is for a 282-sun point-focus concentrating module. Most of the components, subassemblies, and design features incorporate simplifications and ease of manufacturing. The Solar Kinetics, Inc. (SKI) module is designed to incorporate high-efficiency, single-crystal silicon PV cells. The housing is made with aluminum laminated for voltage stand-off and simultaneously providing high thermal conductivity. The Fresnel lens injection molded by American Optical (AO) as singles. The cell assembly consists of a copper heat spreader, a photovoltaic cell soldered, a top and bottom contact, and a reflective secondary optical element (SOE). The cell assemblies passed all of the initial electrical characterization and high-potential tests. Under environmental cycling, the only bond that failed was the PV cell-to-heat spreader interface. The other components (top contact, bottom contact, SOE) passed all the environmental cycling tests. The cell assemblies were designed to be mounted onto the receiver section with a thermally conductive RTV. This geometry was subjected to environmental testing. There was no delamination of this bond nor was there electrical breakdown when the assemblies were subjected to the hi-pot test. A mock module was fabricated for environmental evaluation. This module was subjected to the humidity/freeze cycling to assess the performance of the lens mounting design. This module was also subjected to the rain test after the humidity/freeze cycling and checked for water leaks. The lens showed small displacement from its original position after the environmental cycling. One tablespoon of water did collect inside the module. DOE

N93-16680*# Auburn Univ., AL. Space Power Inst.
HYPERVELOCITY IMPACT EFFECTS ON SOLAR CELLS Final Technical Report, 30 Mar. - 29 Sep. 1992
M. Frank Rose 29 Sep. 1992 6 p
(Grant NAG8-39131)
(NASA-CR-191802; NAS 1.26:191802) Avail: CASI HC A02/MF A01

One of the space hazards of concern is the problem of natural matter and space debris impacting spacecraft. In addition to mechanical damage, impact velocities greater than 5 km/sec can produce shock induced ionization effects with resultant surface charging and complex chemical interactions. The upper limit of the velocity distribution for these particles is on the order of 70 km/sec. The second source of particulate matter is due to the presence of man and the machinery needed to place satellites in orbit. This 'man made' component of the space debris consists of waste, rocket exhaust, and debris caused by satellite break-up. Most of the particles are small. However as the size increases, debris purposefully thrown overboard such as garbage and human waste, combined with paint

chips, plastic, wire fragments, bolts, etc., become formidable hazards which completely dominate the distribution function for some orbits. These larger fragments can produce penetration and spalling of the thick metallic structures associated with spacecraft. The particles most often encountered are aluminum oxide, associated with fuel residue, and paint chips. These debris types can have a wide range of particle sizes. It has been stated that the design of spacecraft will have to take the debris evolution into account and provide additional suitable armor for key components in the near future. The purpose of this work was to subject samples from solar power arrays, one of the key components of any spacecraft, to a debris flux typical of what might be found in space, and measure the degradation of the power panels after impact. Author

N93-16698*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RESULTS OF THE 1992 NASA/JPL BALLOON FLIGHT SOLAR CELL CALIBRATION PROGRAM
B. E. Anspaugh and R. S. Weiss 1 Oct. 1992 24 p
(NASA-CR-191630; NAS 1.26:191630; JPL-Publ-92-26) Avail: CASI HC A03/MF A01

The 1992 solar cell calibration balloon flight was completed on August 1, 1992. All objectives of the flight program were met. Forty-one modules were carried to an altitude of 119,000 ft (36.3 km). Data telemetered from the modules was corrected to 28 C and 1 AU. The calibrated cells have been returned to 39 participants and can now be used as reference standards in simulator testing of cells and arrays. Author

N93-17008# International Fuel Cells Corp., South Windsor, CT.
ADVANCED WATER-COOLED PHOSPHORIC ACID FUEL CELL DEVELOPMENT
Sep. 1992 86 p
(Contract DE-AC21-88MC-24221)
(DE93-000215; DOE/MC-24221/3130; FCR-12321A) Avail: CASI HC A05/MF A01

This program was conducted to improve the performance and minimize the cost of existing water-cooled phosphoric acid fuel cell stacks for electric utility and on-site applications. The goals for the electric utility stack technology were a power density of at least 175 watts per square foot over a 40,000-hour useful life and a projected one-of-a-kind, full-scale manufactured cost of less than $400 per kilowatt. The program adapted the existing on-site Configuration-B cell design to electric utility operating conditions and introduced additional new design features. Task 1 consisted of the conceptual design of a full-scale electric utility cell stack that meets program objectives. The conceptual design was updated to incorporate the results of material and process developments in tasks 2 and 3, as well as results of stack tests conducted in task 6. Tasks 2 and 3 developed the materials and processes required to fabricate the components that meet the program objectives. The design of the small area and 10-sq. ft. stacks was conducted in task 4. Fabrication and assembly of the short stacks were conducted in task 5 and subsequent tests were conducted in task 6. The management and reporting functions of task 7 provided DOE/METC with program visibility through required documentation and program reviews. This report describes the cell design and development effort that was conducted to demonstrate, by subscale stack test, the technical achievements made toward the above program objectives. DOE

N93-17187# Pacific Northwest Lab., Richland, WA.
EXPECTED BENEFITS OF FEDERALLY-FUNDED THERMAL ENERGY STORAGE RESEARCH
G. E. Spanner, K. K. Daellenbach, K. R. Hughes, D. R. Brown, and M. K. Drost Sep. 1992 91 p
(Contract DE-AC06-76RL-01830)
(DE93-003139; PNL-8290) Avail: CASI HC A05/MF A01

Pacific Northwest Laboratory (PNL) conducted this study for the Office of Advanced Utility Concepts of the US Department of Energy (DOE). The objective of this study was to develop a series of graphs that depict the long-term benefits of continuing DOE's thermal energy storage (TES) research program in four sectors: building heating, building cooling, utility power production, and transportation. The study was conducted in three steps. The first step was to assess the maximum possible benefits technically achievable in each sector. In some sectors, the maximum benefit was determined by a 'supply side' limitation, and in other sectors, the maximum benefit is determined by a 'demand side' limitation. The second step was to apply economic cost and diffusion models to estimate the benefits that are likely to be achieved by TES under two scenarios: (1) with continuing DOE funding of TES research; and (2) without continued funding. The models all cover the 20-year period from 1990 to 2010. The third step was to prepare graphs that show the maximum technical benefits achievable, the estimated benefits with TES research funding, and the estimated benefits in the absence of TES research funding. The benefits of federally-funded TES research are largely in four areas: displacement of primary energy, displacement of oil and natural gas, reduction in peak electric loads, and emissions reductions. DOE

N93-17191# Midwest Research Inst., Golden, CO.
PHOTOVOLTAIC MANUFACTURING TECHNOLOGY REPORT, PHASE 1
A. V. Mason (Spectrolab, Inc., Sylmar, CA.) and D. R. Lillington (Spectrolab, Inc., Sylmar, CA.) Oct. 1992 136 p
(Contract DE-AC02-83CH-10093)
(DE93-000027; NREL/TP-411-5019) Avail: CASI HC A07/MF A02

This report describes subcontracted research by Spectrolab, Inc., to address tasks outlined in the National Renewable Energy Laboratory's (NREL) Letter of Solicitation RC-0-10057. These tasks include the potential of making photovoltaics (PV) a more affordable energy source, as set forth in the goal of the PVMaT project. Spectrolab believes that the DOE cost goals can be met using three different types of cells: (1) silicon concentrator cells; (2) high efficiency GaAs concentrator cells; and (3) mechanically stacked multijunction cells. DOE

N93-17208# Oak Ridge National Lab., TN.
FUTURE DIRECTIONS: INTEGRATED RESOURCE PLANNING
D. C. Bauer and J. Eto (California Univ., Berkeley. Lawrence Berkeley Lab.) 1992 26 p Presented at the American Council for An Energy-Efficient Economy Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA, 30 Aug. - 5 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040867; CONF-920828-10) Avail: CASI HC A03/MF A01

Integrated resource planning or IRP is the process for integrating supply- and demand-side resources to provide energy services at a cost that balances the interests of all stakeholders. It now is the resource planning process used by electric utilities in over 30 states. The goals of IRP have evolved from least cost planning and encouragement of demand-side management to broader, more complex issues including core competitive business activity, risk management and sharing, accounting for externalities, and fuel switching between gas and electricity. IRP processes are being extended to other interior regions of the country, to non-investor owned utilities, and to regional (rather than individual utility) planning bases, and to other fuels (natural gas). The comprehensive, multi-valued, and public reasoning characteristics of IRP could be extended to applications beyond energy, e.g., transportation, surface water management, and health care in ways suggested. DOE

N93-17468# Sandia National Labs., Albuquerque, NM.
ELECTRICAL CHARACTERIZATION OF ELECTROPHORETICALLY COATED ALUMINUM SAMPLES FOR PHOTOVOLTAIC CONCENTRATOR APPLICATION
R. S. Sugimura, G. R. Mon, and R. G. Ross, Jr. (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) Oct. 1992 31 p
(Contract DE-AC04-76DP-00789)
(DE93-003229; SAND-92-7294) Avail: CASI HC A03/MF A01

The practicality of using a thin-film styrene/acrylate copolymer electrophoretic coating to isolate concentrator cells electrically from their surroundings in a photovoltaic concentrator module is assessed. Only the electrical isolation problem was investigated. The approach was to subject various types of EP-coated aluminum specimens to electrical stress testing and to aging tests while monitoring coating electrical resistivity properties. It was determined that, in general, longer processing times--i.e., thicker electrophoretic layers--resulted in better voltage-withstand properties. In particular, a two-minute processing time seemed sufficient to provide the electrical isolation required in photovoltaic concentrator application applications. Even though electrophoretic coatings did not seem to fill voids in porous-anodized aluminum substrates, breakdown voltages generally exceeded hi-pot pass-fail voltage levels with a comfortable margin. DOE

N93-17471# Colorado Univ., Boulder.
REACTION KINETICS AND PRODUCT DISTRIBUTIONS IN PHOTOELECTROCHEMICAL CELLS
C. A. Koval 1992 5 p
(Contract DE-FG02-84ER-13247)
(DE93-003885; DOE/ER-13247/8) Avail: CASI HC A01/MF A01

Hot electron reaction studies at p-InP/CH3CN interface revealed essential/desirable features for redox systems used to investigate hot carriers in photoelectrocehmical cells. Reduction of dibromoethylbenzene (DBEB) in presence of metallocene couples is being studied using rotating rink disk electrodes of n-and p-InP disks and Pt rings. At highly doped p-InP electrodes, reduction of DBEB can be very efficient (greater than 30 percent). A mini-electrochemical cell was used to investigate electron transfer at nonilluminated n-WSe2/dimethylferrocene (sup +/0) interfaces. DOE

N93-17574# International Fuel Cells Corp., South Windsor, CT.
ADVANCED WATER-COOLED PHOSPHORIC ACID FUEL CELL DEVELOPMENT
May 1992 14 p
(Contract DE-AC21-88MC-24221)
(DE93-003358; DOE/MC-24221/3143; FCR-12285) Avail: CASI HC A03/MF A01

This program is being conducted to improve the performance and minimize the cost of water cooled, electric utility phosphoric acid fuel cell stacks. The program adapts the existing on-site Configuration B cell design to electric utility operating conditions and introduces additional new design features. Task 1 consists of the conceptual design of a full-scale electric utility cell stack that meets program objectives. Tasks 2 and 3 develop the materials and processes requested to fabricate the components that meet the program objective. The design of the small area and two 10-ft(exp 2) short stacks is conducted in Task 4. The conceptual design also is updated to incorporate the results of material and process developments, as well as results of stack tests conducted in Task 6. Fabrication and assembly of the short stacks are conducted in Task 5 and subsequent tests are conducted in Task 6. The Contractor expects to enter into a contract with the Electric Power Research Institute (EPRI) to assemble and endurance test the second 10-ft(exp 2) short stack. The management and reporting functions of Task 7 provide DOE/METC with program visibility through required documentation and program reviews. This report describes the cell design and development effort that is being conducted to demonstrate, by subscale stack test, the technical achievements made toward the above program objectives. DOE

N93-17650# Midwest Research Inst., Golden, CO.
LOW-COST CuInSe2 SUBMODULE DEVELOPMENT Final Report, 9 Jul. 1990 - 31 Jan. 1992
B. M. Basol, V. K. Kapur, A. Halani, and C. Leidholm Oct. 1992 39 p Prepared in cooperation with International Solar Electric Technology, Inglewood, CA
(Contract DE-AC02-83CH-10093)
(DE92-016438; NREL/TP-413-5010) Avail: CASI HC A03/MF A01

The aim of this project is the development and demonstration of processing steps necessary for fabrication of high efficiency CuInSe2 solar cells and submodules by the two-stage technique (also called the selenization method). During this period, we have optimized the processing parameters of this method and demonstrated CuInSe2/CdS/ZnO devices with a 1-4 sq cm area and up to 12.4 percent active area efficiency. We have also developed a novel approach for the preparation of Cu/In precursors that improved the stoichiometric and morphological uniformity in these films. We have developed processing steps and tooling for handling up to 1 sq ft. size substrates and as a result of these efforts demonstrated our first monolithically integrated submodule of 1 sq ft. area. DOE

N93-17717# Naval Postgraduate School, Monterey, CA.
SUN SENSOR IMPLEMENTATION USING SOLAR POWER ARRAYS M.S. Thesis
Irma Sityar Sep. 1992 82 p
(AD-A257627) Avail: CASI HC A05/MF A01

This thesis explores the feasibility of utilizing a satellite's solar cell power arrays as a sun sensor. Power output of a solar cell is highly dependent on the intensity and direction of sunlight that falls on the panel and thus provides an indication of the sun's orientation. A sun sensor can be obtained by processing the power signal generated in each solar cell panel. This concept was applied to the Naval Postgraduate School's Petite Amateur Navy Satellite (PANSAT), a 26 sided polyhedral shaped satellite with 17 body mounted square panels. Two circuit configurations to meter the power signals generated in the 17 individual solar panels were investigated. It was possible in one configuration to develop a prediction model of each panel's short circuit current versus sun angle. Compensation for seasonal variations in solar flux, solar cell degradation due to radiation and panel temperature variation is required. An estimation of the resulting sun sensor's resolution and accuracy is given. GRA

N93-16907*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TECHNOLOGIES
Henry W. Brandhorst, Jr. *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 12-32
(For primary document see N93-16905 05-91)
Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N93-15663# Los Alamos National Lab., NM.
THE SWOOPE EXPERIENCE: PRECOLLEGE STUDENTS MAPPING THE ENVIRONMENT
R. C. Eckhardt and D. K. Hyer 1992 11 p Presented at the New Mexico Conference on the Environment: Toward a Sustainable Environment, Albuquerque, NM, 13-15 Sep. 1992
(Contract W-7405-eng-36)
(DE92-040390; LA-UR-92-2524; CONF-9209164-6) Avail: CASI HC A03/MF A01

SWOOPE (Students Watching Over Our Planet Earth) is an innovative environmental science education program for teachers and students sponsored by the Department of Energy and developed at the Los Alamos National Laboratory. The students, kindergarten through high school, gather data on an item of concern in the environment and send some of those data to a database at Los Alamos. Discussions and graphs of their results are sent back to them in newsletters. One of the key ideas of the program is to involve the students in the process of science. They learn how to gather the data through a variety of hands-on science activities in the classroom and then take the measuring devices home to gather data in their own environment. Frequently, this involves their parents in the process as well. Although the measuring devices are usually simple and inexpensive, they are true scientific instruments, capable of gathering meaningful data. The collected data are available to scientists, agencies, and the community at large. Thus, the students participate in a truly collaborative scientific effort. Two SWOOPE Discovery Units, Water Quality and Radiation and Radon, were developed by teachers at summer institutes and have been piloted in the classroom over a two-year period. Currently, 112 teachers and almost 5000 students are using the materials. Data collected by students in the Radiation and Radon Unit include radon measurements and background measurements of ionizing radiation. The student data on radon are being used in a study of home radon levels in New Mexico by the New Mexico Environment Department. Students in the Water Quality Unit are gathering data on city, ground and surface water that should also prove useful to environmental scientists. The water measurements include pH, temperature, turbidity, hardness, and the concentrations of nitrates, chlorine, and coliform bacteria. DOE

N93-15811# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
CARBON EMISSIONS AND SEQUESTRATION IN FORESTS: CASE STUDIES FROM SEVEN DEVELOPING COUNTRIES. VOLUME 3: INDIA AND CHINA
Willy Makundi, ed., Jayant Sathaye, ed., N. H. Ravindranath (Indian Inst. of Science, Bangalore.), B. S. Somashekhar (Indian Inst. of Science, Bangalore.), and M. Gadgil (Indian Inst. of Science, Bangalore.) Aug. 1992 55 p
(Contract DE-AC03-76SF-00098)
(DE93-001600; LBL-32759) Avail: CASI HC A04/MF A01

As part of the effort to understand the sources of carbon dioxide and other major greenhouse gases, the Tropical Forestry and Global Climate Change Research Network (F-7) was established. The countries taking part in the F-7 Network--Brazil, China, India, Indonesia, Malaysia, Mexico, Nigeria, and Thailand--possess large tracts of tropical forests and together experience the bulk of large scale tropical deforestation. Integration of work of indigenous researchers and institutions from the participating countries should allow for the gathering of on-site information into the more general and universally available base of knowledge. The information contained in this report represents the results of the first phase of the F-7 project, which had the explicit aim of providing quantitative data on forestry-related carbon emissions from India and China. DOE

N93-15852# Sandia National Labs., Albuquerque, NM.
THE FORMAL USE OF EXPERT JUDGMENTS IN ENVIRONMENTAL MANAGEMENT
E. J. Bonano 1992 25 p Presented at the Eurocourse: Technologies for Environmental Cleanup - Soil and Groundwater, Ispra, Italy, 21-25 Sep. 1992
(Contract DE-AC04-76DP-00789)
(DE92-019481; SAND-92-1689C; CONF-9209159-3) Avail: CASI HC A03/MF A01

The solution of ER/WM problems will rely on the use of expert judgments. These judgments should be able to withstand the same rigorous scrutiny as the decisions made to solve these problems. Therefore, those judgments that are likely to have a significant impact on the solution of ER/WM problems should be elicited and used in a formal manner. In this paper, we discuss the key areas of environmental management where expert judgments are expected to be crucial, as well as the process to formalize them. This process is a generic one and should only be construed as a roadmap; specific aspects of the process need to be tailored to address the problem at hand. By employing this process, the quality of the judgments is enhanced, and therefore, the likelihood that the solution of ER/WM problems will be a sound and defensible one is considerably increased. DOE

N93-15853# Oak Ridge National Lab., TN.
PC-BASED EXPERT SYSTEM FOR INTEGRATED ASSESSMENT OF ENVIRONMENTAL COMPLIANCE
G. M. Caton, R. T. Haas, J. C. Haufe, M. W. Francis, and Po-Yung Lu 1992 32 p Presented at the 204th American Chemical Society National Meeting, Washington, DC, 23-28 Aug. 1992
(Contract DE-AC05-84OR-21400)
(DE92-019964; CONF-920815-6) Avail: CASI HC A03/MF A01

The Biomedical and Environmental Information Analysis Section at Oak Ridge National Laboratory has developed expert systems that cost effectively facilitate the documentation of compliance with DOE, federal, and state regulations. The systems, that are user-friendly and require little knowledge of computers, provide context-specific instructions and definitions on the screen. They are self-contained and most do not require proprietary software. The knowledge base and rules of decision making obtained from experts and legislation are incorporated in the systems. Input data are validated to ensure consistency and completeness and are stored in databases transparent to the user. Emphasis in this talk is on the Internal Assessment of Environmental Compliance system. This flexible system collects information on compliance with 12 different environmental laws/regulations from several organizational units. The information is integrated in a central location and noncompliances are identified. Reports, statistics, and trend analyses can be generated from the stored information. DOE

N93-15916*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
FINGERPRINTING OF MATERIALS Final Report
Gary L Workman (Alabama Univ., Huntsville.) 30 Sep. 1992 201 p
(Contract NAS8-38609)
(NASA-CR-184482; NAS 1.26:184482) Avail: CASI HC A10/MF A03

Recent issues emerging in our fiscal and ecological environments have promulgated that federal agencies shall promote activities which respond to the improvement of both. In response to these developments, the National Aeronautics and Space Administration (NASA) has undertaken an innovative approach to improve the control of materials used in all NASA manufacturing activities. In concert with this goal, NASA is requiring that its contractors and their sub-contractors perform a more intensive consolidation of technologies that can provide an accounting of materials, which includes in-coming materials, materials in process, end-products and waste materials. The purpose of this handbook is to provide guidelines to NASA and its contractor personnel for the planning and implementation of chemical fingerprinting programs and to illustrate the chemical and statistical fundamentals needed for successful use of chemical fingerprinting. For individual titles, see N93-15917 through N93-15917.

N93-15917*# Alabama Univ., Huntsville.
FINGERPRINTING OF MATERIALS: TECHNICAL SUPPLEMENT
Gary L. Workman *In* NASA. Marshall Space Flight Center, Fingerprinting of Materials 30 Sep. 1992 125 p (For primary document see N93-15916 05-45)
Avail: CASI HC A06/MF A03

This supplement to the Guidelines for Maintaining a Chemical Fingerprinting Program has been developed to assist NASA personnel, contractors, and sub-contractors in defining the technical aspects and basic concepts which can be used in chemical fingerprinting programs. This material is not meant to be totally inclusive to all chemical fingerprinting programs, but merely to present current concepts. Each program will be tailored to meet the needs of the individual organizations using chemical fingerprinting to improve their quality and reliability in the production of aerospace systems. Author

N93-15974# Argonne National Lab., IL.
GLOBAL CLIMATE CHANGE: SOCIAL AND ECONOMIC RESEARCH ISSUES
M. Rice, ed., J. Snow, ed., and H. Jacobson, ed. May 1992 126 p Presented at the Global Climate Change: Social and Economic Research Issues, Argonne, IL, 11-13 Feb. 1992
(Contract W-31-109-eng-38)
(DE92-041151; ANL/RP-76523; CONF-9202127) Avail: CASI HC A07/MF A02

This workshop was designed to bring together a group of scholars, primarily from the social sciences, to explore research that might help in dealing with global climate change. To illustrate the state of present understanding, it seemed useful to focus this workshop on three broad questions that are involved in coping with climate change. These are as follows: (1) How can the anticipated economic costs and benefits of climate change be identified?; (2) How can the impacts of climate change be adjusted to or avoided?; and (3) What previously studied models are available for institutional management of the global environment? The resulting discussions may accomplish the following: (1) identify worthwhile avenues for further social science research; (2) help develop feedback for natural scientists about research information from this domain needed by social scientists; and (3) provide policy makers with the sort of relevant research information from the social science community that is currently available. DOE

N93-16045# California Univ., Berkeley. Lawrence Berkeley Lab.
ENERGY ANALYSIS PROGRAM
M. D. Levine Jul. 1992 51 p
(Contract DE-AC03-76SF-00098)
(DE93-001570; LBL-32108) Avail: CASI HC A04/MF A01

Energy and the environment are at the forefront of many agendas: at the national level, Congress and the Department of Energy have discussed comprehensive energy legislation for the first time in more than ten years; at the state level, state government programs actively encourage energy efficiency; many more active public utility regulatory commissions have emerged; utilities are promoting demand-side programs to increase profits in several key states on the East and West Coasts; and other local agencies have also become involved. For the first time, energy issues are an important element of the international agenda as well: a framework convention on greenhouse gas emissions is currently under discussion as the major nations make preparations for the United Nations Conference on Environment and Development in Brazil. We continue to place highest emphasis on analyzing energy efficiency, with particular attention given to energy use in buildings. The Program continues its active analysis of international energy issues in Asia (including China), Eastern Europe, the former Soviet Union, South America, and Western Europe. Analyzing the costs and benefits of different levels of standards for residential appliances

continues to be the largest single area of research within the Program, although increases in federal support for a wide range of energy issues relating to global climate change may shortly become our largest analytic activity. DOE

N93-16085# Oak Ridge National Lab., TN.
ENERGY AND GLOBAL WARMING IMPACTS OF CFC ALTERNATIVE TECHNOLOGIES FOR FOAM BUILDING INSULATIONS
S. K. Fischer, P. D. Fairchild, and P. J. Hughes 1992 15 p Presented at the Thermal Performance of the Exterior Envelopes of Buildings, Clearwater, FL, 7-10 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE92-019477; CONF-921203-1) Avail: CASI HC A03/MF A01

Chlorofluorocarbons (CFC's) have been used as blowing agents in foam insulation, as the working fluids in cooling and refrigeration equipment, and as solvents in general and precision cleaning applications since their introduction in the 1930s. The number of applications and volumes of CFC's used grew at a tremendous pace during the 1960s and 1970s, but in the mid-1980s it was confirmed that these extremely useful chemicals contribute to the destruction of stratospheric zone and that they are the primary cause of the Antarctic ozone hole. CFC's have also been found to be second only to carbon dioxide as a factor causing increased greenhouse warming. These chemicals are being phased out of use rapidly to protect the ozone layer and it is very important that the replacements for CFC's do not result in a net increase in global warming by introducing less efficient processes that lead to higher energy use and increased carbon dioxide emissions. A study was conducted to identify those alternative chemicals and technologies that could replace CFC's in energy related applications before the year 2000, and to assess the total potential impact of those alternatives on global warming. The analysis for this project included an estimate of the direct effects from the release of blowing agents, refrigerants, and solvents into the atmosphere and the indirect effects of carbon dioxide emissions resulting from energy use for commercial and residential building insulation, household and commercial refrigeration, building and automobile air conditioning, and general metal and electronics solvent cleaning. This paper focuses on those aspects of the study relevant to building insulation. In general the hydrofluorocarbon (HFC) and hydrochlorofluorocarbon alternatives for CFC's lead to large and sometimes dramatic reductions in total equivalent warming impact, lifetime equivalent CO2 emissions (TEWI). Most of the reductions result from decreased direct effects without significant changes in energy use. DOE

N93-16092# California Univ., Berkeley. Lawrence Berkeley Lab.
CARBON EMISSIONS AND SEQUESTRATION IN FORESTS: CASE STUDIES FROM SEVEN DEVELOPING COUNTRIES. VOLUME 2: GREENHOUSE GAS EMISSIONS FROM DEFORESTRATION IN THE BRAZILIAN AMAZON
Willy Makundi, ed., Jayant Sathaye, ed., and Philip M. Fearnside Aug. 1992 73 p Prepared in cooperation with EPA, Washington, DC
(Contract DE-AC03-76SF-00098)
(DE93-001526; LBL-32758-Vol-2) Avail: CASI HC A04/MF A01

Deforestation in Brazilian Amazonia in 1990 was releasing approximately 281-282 x 10(exp 6) metric tons (MT) of carbon on conversion to a landscape of agriculture, productive pasture, degraded pasture, secondary forest, and regenerated forest in the proportions corresponding to the equilibrium condition implied by current land-use patterns. Emissions are expressed as 'committed carbon', or the carbon released over a period of years as the carbon stock in each hectare deforested approaches a new equilibrium in the landscape that replaces the original forest. To the extent that deforestation rates have remained constant, current releases from the areas deforested in previous years will be equal to the future releases from the areas being cleared now. Considering the quantities of carbon dioxide, carbon monoxide, methane, nitrous oxide, NO(x), and non-methane hydrocarbons released raises the impact by 22-37 percent. The relative impact on the greenhouse effect of each gas is based on the Intergovernmental Panel on Climate Change (IPCC) calculations over a 20-year time period (including indirect effects). The six gases considered have a combined global warming impact equivalent to 343 to 386 million MT of CO2-equivalent carbon, depending on assumptions regarding the release of methane and other gases from the various sources such as burning and termites. These emissions represent 7-8 times the 50 million MT annual carbon release from Brazil's use of fossil fuels, but bring little benefit to the country. Stopping deforestation in Brazil would prevent as much greenhouse emission as tripling the fuel efficiency of all the automobiles in the world. The relatively cheap measures needed to contain deforestation, together with the many complementary benefits of doing so, make this the first priority for funds intended to slow global warming. DOE

N93-16137# Visidyne, Inc., Burlington, MA.
BASIC RESEARCH IN THE MEASUREMENT, ANALYSIS, AND MODELING OF ATMOSPHERIC EMISSIONS
J. W. Carpenter, C. J. Beeler, T. M. Codella, G. E. Galica, and M. E. Gardner Dec. 1991 74 p
(Contract F19628-90-C-0187)
(AD-A256708; PL-TR-92-2026; AD-E201215; SR-1) Avail: CASI HC A04/MF A01

The objectives of this study were to perform basic research in several areas related to optical and infrared systems technology. The areas include: (1) Modeling of High Temperature Molecular Data; (2) Cloud Background Measurement, Analysis, and Modeling; (3) High Altitude Atmospheric Emissions; and (4) Analysis of Satellite Data. Work in these areas included modeling CO2 and H2O emissions, supporting the Infrared Background Signature Survey (IBSS), providing the CIRRIS 1A experiment with a variety of task supports, designing earthlimb radiance structure measurement experiments for the MSX flights, modeling high altitude water emissions, and analyzing spectral, spatial, temporal data from some of the instrumentation for the EXCEDE 3 atmospheric energy deposition experiment. GRA

N93-16139# Naval Research Lab., Washington, DC.
A CLOUD CHAMBER STUDY OF THE EFFECT WHICH NONPRECIPITATING CLOUDS HAVE ON THE AEROSOL SIZE DISTRIBUTION Interim Report
G. M. Frick, W. A. Hoppel, J. W. Fitzgerald, and B. J. Wattle 30 Sep. 1992 50 p
(AD-A256730; NRL/FR/4212-92-9514) Avail: CASI HC A03/MF A01

When an air parcel in the atmosphere passes through a nonprecipitating cloud cycle, a subset of the aerosol population called cloud condensation nuclei (CCN) is activated and forms cloud droplets. During the cloud phase, trace gases, such as SO2, are dissolved into the droplets and undergo aqueous-phase chemical reactions, forming low-volatility products, such as sulfates, which remain as residue when the cloud droplets evaporate. The resulting increase in residual mass can have a dramatic effect on the aerosol size distribution, causing the CCN to grow relative to the smaller particles (interstitial aerosol) which were not activated in the cloud. This process was graphically demonstrated in a series of experiments carried out in the Calspan 600 m3 environmental chamber, under conditions where the precloud reactants could be carefully controlled. Size distributions taken before and after a cloud cycle showed significant conversion of SO2 to H2SO4 and a dramatic change in the aerosol size distribution. Subsequent cloud cycles (with the same expansion rate and trace gas concentrations) exhibited very small mass conversion rates. The decreased conversion rate is explained by the increased acidity of the cloud droplet due to the increased mass of the CCN. The terminal size of the resulting CCN was on the order of one-fiftieth the size of the cloud droplets. The pH of a droplet formed on a sulfuric acid aerosol particle one-fiftieth its size is about 5. GRA

N93-16162# Atmospheric and Environmental Research, Inc., Cambridge, MA.
NATURAL AND ANTHROPOGENIC CLIMATE CHANGE
D. A. Portman, W. J. Gutowski, Jr., W. C. Wang, M. J. Iacono, and S. Yang 31 Aug. 1992 20 p
(Contract DE-FG02-86ER-60422)
(DE93-000898; DOE/ER-60422/7) Avail: CASI HC A03/MF A01

This final report provides a broad overview of program accomplishments. Brief descriptions are provided for accomplishments with respect to intercomparisions and improvements in general circulation models, analysis of climatic data and climate model statistics, and accomplishments in the China Meteorology coordination. DOE

N93-16176# Brown Univ., Providence, RI.
SENSITIVITY OF CLIMATE MODELS: COMPARISON OF SIMULATED AND OBSERVED PATTERNS FOR PAST CLIMATES
W. L. Prell and T. Webb, III Aug. 1992 16 p
(Contract DE-FG02-85ER-60304)
(DE93-000893; DOE/ER-60304/8) Avail: CASI HC A03/MF A01

Predicting the potential climatic effects of increased concentrations of atmospheric carbon dioxide requires the continuing development of climate models. Confidence in the predictions will be much enhanced once the models are thoroughly tested in terms of their ability to simulate climates that differ significantly from today's climate. As one index of the magnitude of past climate change, the global mean temperature increase during the past 18,000 years is similar to that predicted for carbon dioxide--doubling. Simulating the climatic changes of the past 18,000 years, as well as the warmer-than-present climate of 6000 years ago and the climate of the last interglacial, around 126,000 years ago, provides an excellent opportunity to test the models that are being used in global climate change research. During the past several years, we have used paleoclimatic data to test the accuracy of the National Center for Atmospheric Research, Community Climate Model, Version 0, after changing its boundary conditions to those appropriate for past climates. We have assembled regional and near-global paleoclimatic data sets of pollen, lake level, and marine plankton data and calibrated many of the data in terms of climatic variables. We have also developed methods that permit direct quantitative comparisons between the data and model results. Our research has shown that comparing the model results with the data is an evolutionary process, because the models, the data, and the methods for comparison are continually being improved. During 1992, we have completed new modeling experiments, further analyzed previous model experiments, compiled new paleodata, made new comparisons between data and model results, and participated in workshops on paleoclimatic modeling. DOE

N93-16191# Department of Energy, Washington, DC.
CLIMATE CHANGE AND RELATED ACTIVITIES
1992 17 p
(DE93-000477; DOE/PE-0105P) Avail: CASI HC A03/MF A01

The production and consumption of energy contributes to the concentration of greenhouse gases in the atmosphere and is the focus of other environmental concerns as well. Yet the use of energy contributes to worldwide economic growth and development. If we are to achieve environmentally sound economic growth, we must develop and deploy energy technologies that contribute to global stewardship. The Department of Energy carries out an aggressive scientific research program to address some of the key uncertainties associated with the climate change issue. Of course, research simply to study the science of global climate change is not enough. At the heart of any regime of cost-effective actions to address the possibility of global climate change will be a panoply of new technologies; technologies both to provide the services we demand and to use energy more efficiently than in the past. These, too, are important areas of responsibility for the Department. This report is a brief description of the Department's activities in scientific research, technology development, policy studies, and international cooperation that are directly related to or have some bearing on the issue of global climate change. DOE

N93-16271# Oak Ridge National Lab., TN.
ENVIRONMENTAL QUALITY INFORMATION ANALYSIS CENTER (EQIAC) OPERATING PROCEDURES HANDBOOK
T. E. Walsh (Florida Univ., Gainesville.) and S. Das Aug. 1992 51 p
(Contract DE-AC05-84OR-21400)
(DE92-041391; ORNL/TM-12144) Avail: CASI HC A04/MF A01

The Operating Procedures Handbook of the Environmental Quality Information Analysis Center (EQIAC) is intended to be kept current as EQIAC develops and evolves. Its purpose is to provide a comprehensive guide to the mission, infrastructure, functions, and operational procedures of EQIAC. The handbook is a training tool for new personnel and a reference manual for existing personnel. The handbook will be distributed throughout EQIAC and maintained in binders containing current dated editions of the individual sections. The handbook will be revised at least annually to reflect the current structure and operational procedures of EQIAC. The EQIAC provides information on environmental issues such as compliance, restoration, and environmental monitoring to Air Force and DOD contractors. DOE

N93-16298# Lawrence Livermore National Lab., CA.
SENSITIVITY OF DIRECT GLOBAL WARMING POTENTIALS TO KEY UNCERTAINTIES
D. J. Wuebbles, K. O. Patten, K. E. Grant, and A. K. Jain Jul. 1992 48 p
(Contract W-7405-eng-48)
(DE92-041045; UCRL-ID-111461) Avail: CASI HC A03/MF A01

A series of sensitivity studies examines the effect of several uncertainties in Global Warming Potentials (GWP's). For example, the original evaluation of GWP's for the Intergovernmental Panel on Climate Change (EPCC, 1990) did not attempt to account for the possible sinks of carbon dioxide (CO2) that could balance the carbon cycle and produce atmospheric concentrations of CO2 that match observations. A balanced carbon cycle model is applied in calculation of the radiative forcing from CO2. Use of the balanced model produces up to 20 pct. enhancement of the GWP's for most trace gases compared with the EPCC (1990) values for time horizons up to 100 years, but a decreasing enhancement with longer time horizons. Uncertainty limits of the fertilization feedback parameter contribute a 10 pct. range in GWP values. Another systematic uncertainty in GWP's is the assumption of an equilibrium atmosphere (one in which the concentration of trace gases remains constant) versus a disequilibrium atmosphere. The latter gives GWP's that are 15 to 30 pct. greater than the former, dependening upon the CO2 emission scenario chosen. Seven scenarios are employed: constant emission past 1990 and the six EPCC (1992) emission scenarios. For the analysis of uncertainties in atmospheric lifetime (tau), the GWP changes in direct proportion to tau for short lived gases, but to a lesser extent for gases with tau greater than the time horizon for the GWP calculation. DOE

N93-16363# Sandia National Labs., Albuquerque, NM.
DESCRIPTION AND VALIDATION OF ERAD: AN ATMOSPHERIC DISPERSION MODEL FOR HIGH EXPLOSIVE DETONATIONS
B. A. Boughton and J. M. DeLaurentis Oct. 1992 80 p
(Contract DE-AC04-76DP-00789)
(DE93-002515; SAND-92-2069) Avail: CASI HC A05/MF A01

The Explosive Release Atmospheric Dispersion (ERAD) model is a three-dimensional numerical simulation of turbulent atmospheric transport and diffusion. An integral plume rise technique is used to provide a description of the physical and thermodynamic properties of the cloud of warm gases formed when the explosive detonates. Particle dispersion is treated as a stochastic process which is simulated using a discrete time Lagrangian Monte Carlo method. The stochastic process approach permits a more fundamental treatment of buoyancy effects, calm winds, and spatial variations in meteorological conditions. Computational requirements of the three-dimensional simulation are substantially reduced by using a conceptualization in which each Monte Carlo particle represents a small puff that spreads according to a Gaussian law in the horizontal directions. ERAD was evaluated against dosage and deposition measurements obtained during Operation Roller Coaster. The predicted contour areas average within about 50 percent of the observations. The validation results confirm the model's representation of the physical processes. DOE

N93-16497# Oak Ridge National Lab., TN. Carbon Dioxide Information Analysis Center.
THE GLOBAL HISTORICAL CLIMATOLOGY NETWORK: LONG-TERM MONTHLY TEMPERATURE, PRECIPITATION, SEA LEVEL PRESSURE, AND STATION PRESSURE DATA
R. S. Vose (Tennessee Univ., Knoxville.), R. L. Schmoyer, P. M. Steurer (National Climatic Data Center, Asheville, NC.), T. C. Peterson (National Climatic Data Center, Asheville, NC.), R. Heim (National Climatic Data Center, Asheville, NC.), and T. R. Karl (National Climatic Data Center, Asheville, NC.) Jul. 1992 317 p
(Contract DE-AC05-84OR-21400)
(DE92-040521; ORNL/CDIAC-53; NDP-041; ESDP-3912) Avail: CASI HC A14/MF A03

Interest in global climate change has risen dramatically during the last several years. In a similar fashion, the number of data sets available to study global change has also increased. Unfortunately, these data sets have been compiled by many different organizations/researchers, making it confusing and time consuming for individual researchers to acquire the 'best' data. In response to this rapid growth in the number of global data sets, the Carbon Dioxide Information Analysis Center (CDIAC) and the

National Climatic Data Center (NCDC) commenced the Global Historical Climatology Network (GHCN) project. The purpose is to compile an improved global base-line data set of long-term monthly mean temperature, precipitation, sea level pressure, and station pressure for a dense network of worldwide meteorological stations. Specifically, the GHCN project seeks to consolidate the numerous preexisting national, regional, and global scale data sets into a single global climate data base that can be updated, enhanced, and distributed at regular intervals. The first version of the GHCN data base was completed during the summer of 1992. It contains 6039 temperature, 7533 precipitation, 1883 sea level pressure, and 1873 station pressure stations. All stations have at least 10 years of data, 40 pct. have more than 50 years of data, and 10 pct. have more than 100 years of data. Spatial coverage is good over most of the globe, particularly for the United States and central Europe. In comparison to other major global data sets, dramatic improvements are evident over South America, Africa, and Asia. The GHCN data base is available as a Numeric Data Package (NDP) from CDIAC. The NDP consists of this document and two magnetic tapes that contain machine-readable data files and accompanying retrieval codes. This document describes, in detail, both the GHCN data base and the contents of the magnetic tap. DOE

N93-16502# Army Construction Engineering Research Lab., Champaign, IL.

ENVIRONMENTAL REVIEW GUIDE FOR OPERATIONS (ERGO) Final Report

Diane K. Mann, Tina M. Beckler, and Donald H. Wiggins Jan. 1992 576 p

(AD-A256922; CERL-SR-N-92/05) Avail: CASI HC A25/MF A04

Because of the growing number of environmental laws and regulations worldwide, the U.S. Army Corps of Engineers has adopted an environmental compliance program that includes a mechanism to identify compliance problems before they become notices of violation by the U.S. Environmental Protection Agency. In 1989, the U.S. Army Construction Engineering Research Laboratory, in cooperation with Headquarters, U.S. Army Corps of Engineers Directorate of Civil Works, began work on the Environmental Review Guide for Operations (ERGO). The concept combines Federal and Engineering environmental regulations, along with good management practices and risk management issues, into a series of checklists showing not only the legal requirements, but also what specific items or operations to review. In addition, each question or protocol lists a point of contact to help assessors review the protocols as easily as possible. GRA

N93-16535# Utah Univ., Salt Lake City. Dept. of Meteorology.

CLOUD AND AEROSOL CHARACTERIZATION FOR THE ARM CENTRAL FACILITY: MULTIPLE REMOTE SENSOR TECHNIQUES DEVELOPMENT

K. Sassen 30 Apr. 1992 7 p

(Contract DE-FG02-90ER-61059)

(DE93-000915; DOE/ER-61059/1) Avail: CASI HC A02/MF A01

This research project designed to investigate how atmospheric remote sensing technology can best be applied to the characterization of the cloudy atmosphere. Our research program addresses basic atmospheric remote sensing questions, but at the same time is clearly directed toward providing information crucial to the ARM (Atmospheric Remote Sensing) program and for application to the Clouds and Radiation Testbed (CART). The instrumentation that is being brought into play includes a variety of art-of-the-art sensors. Available at NOAA WPL are polarization Doppler Ka-band (0.86 mm) and X-band (3.2 cm) radars, a CO2 (10.6 (mu)m) Doppler lidar with sequential polarization measurement capabilities, a three-channel (20.6, 31.65 and 90 GHz) microwave radiometer, and variety of visible and infrared radiometers. Instrumentation at the University of Utah Facility for Atmospheric Remote Sensing (FARS) includes a polarization ruby (0.643 (mu)m) lidar, a narrow-beam (0.14 degree) mid-infrared (9.5-11.5 (mu)m) radiometer coaligned with the lidar, several other radiometers in the visible and infrared spectral regions, and an advanced two-color (1.06 and 0.532 (mu)m), four-channel Polarization Diversity Lidar (PDL) and all-sky video imaging system that have only recently been developed under the ARM IDP. DOE

N93-16645*# Maryland Univ., College Park.

DIRECT MEASUREMENTS OF TROPOSPHERIC OZONE FROM TOMS DATA Progress Report

Robert D. Hudson 1 Jan. 1993 12 p Original contains color illustrations

(Grant NAGw-2696)

(NASA-CR-191884; NAS 1.26:191884) Avail: CASI HC A03/MF A01; 3 functional color pages

In the past year, we have made measurements of the tropospheric total column of ozone during the biomass burning season in Africa (August to October). Fishman et. al. had reported previously that by taking a time average of the low spatial resolution data from TOMS (Total Ozone Mapping Spectrometer) on Nimbus-7 (referred to as the Grid-T data set), during the biomass burning season in Africa, a plume of ozone extends from the East coast of Africa into the Atlantic. In this report, we present an analysis that we have made using the measured TOMS radiances taken from the High Density TOMS data set (referred as the HDT data set), which examines this plume in more detail. Author

N93-16737 Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Science.

TRANSPORT OF DESERT AEROSOLS AND THEIR INFLUENCE ON LOCAL TEMPERATURES AND MOTIONS Ph.D. Thesis

Amos Karel Pick Apr. 1991 117 p In HEBREW

(ITN-93-85173) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

Simulations were performed to determine effects on atmospheric temperature and motion fields of the interaction of radiation with aerosol particles. A numerical model was developed which included: horizontal and vertical advection of aerosols; coagulation of aerosol particles; absorption and scattering of shortwave and longwave radiation by air, CO2, H2O and O3 particles; and development of pressure, temperature, geopotential and motion fields. The model simulates 48 hours of development, which is long enough to show the expected changes but short enough not to involve complicated macroscale heat and momentum exchanges. Two simulations were performed: with and without haze and dust particles. The results show that the aerosol can affect atmospheric developments on the local scale immediately, and may influence larger scale motions and processes also. The aerosol cloud leads to temperature changes of about +1C, which disappear with departure of the aerosol cloud. Similarly, there are perturbations of the order of 3-5 mm/sec, which similarly disappear. Temporary changes in horizontal divergence were of the order of 10 to the power -6 per sec, which are about 0.001 of values associated with synoptic developments. After passage of the aerosol cloud, there were residual changes in ground pressure of -0.2 mb and of -5 meters in geopotential of 0.09 sigma level (about 230 mb level). These changes were induced by a haze cloud with an initial horizontal visibility range of 100-200 meters. ISA

N93-16748*# Woods Hole Research Center, MA.

HUMAN IMPACTS ON SOIL CARBON DYNAMICS OF DEEP-ROOTED AMAZONIAN FORESTS AND EFFECT OF LAND USE CHANGE ON THE CARBON CYCLE IN AMAZON SOILS Annual Report No. 1, 1 Sep. 1991 - 30 Aug. 1992

Daniel Nepstad, Thomas Stone, Eric Davidson, and Susan E. Trumbore (California Univ., Irvine.) 14 Oct. 1992 19 p

(Grant NAGw-2750)

(NASA-CR-191219; NAS 1.26:191219) Avail: CASI HC A03/MF A01

The main objective of these NASA-funded projects is to improve our understanding of land-use impacts on soil carbon dynamics in the Amazon Basin. Soil contains approximately one half of tropical forest carbon stocks, yet the fate of this carbon following forest impoverishment is poorly studied. Our mechanistics approach draws on numerous techniques for measuring soil carbon outputs, inputs, and turnover time in the soils of adjacent forest and pasture ecosystems at our research site in Paragominas, state of Para, Brazil. We are scaling up from this site-specific work by analyzing Basin-wide patterns in rooting depth and rainfall seasonality, the two factors that we believe should explain much of the variation in tropical soil carbons dynamics. In this report, we summarize ongoing measurements at our Paragominas study site, progress in employing new field data to understand soil C dynamics, and some surprising results from our regional, scale-up work. Author

N93-17011# Westinghouse Savannah River Co., Aiken, SC.
ENVIRONMENTAL RESTORATION PROGRAM CONTROL MANAGEMENT SYSTEM
R. T. Duke 13 Aug. 1992 12 p Presented at the 19th Annual National Energy and Environmental Quality Div. of the American Society for Quality Control Conference, Lake Buena Vista, FL, 20-23 Sep. 1992
(Contract DE-AC09-89SR-18035)
(DE93-000469; WSRC-MS-92-315; CONF-920988-1) Avail: CASI HC A03/MF A01

Environmental restoration managers need to demonstrate that their programs are under control. Unlike most industrial programs, the public is heavily involved in environmental restoration activities. The public is demanding that the country prove that real progress is being made towards cleaning up the environment. A Program Control Management System can fill this need. It provides a structure for planning, work authorization, data accumulation, data analysis, and change control. But it takes time to implement a control system and the public is losing its patience. This paper describes critical items essential to the quick development and implementation of a successful control system. DOE

N93-17050# Pacific Northwest Lab., Richland, WA.
SINGLE-STATION INTEGRAL MEASURES OF ATMOSPHERIC STAGNATION, VENTILATION, AND RECIRCULATION
K. J. Allwine and C. D. Whiteman Sep. 1992 6 p Presented at the 6th American Meteorological Society Conference on Mountain Meteorology, Portland, OR, 29 Sep. - 2 Oct. 1992
(Contract DE-AC06-76RL-01830)
(DE93-001554; PNL-SA-20899; CONF-9209163-2) Avail: CASI HC A02/MF A01

In air pollution work, terms such as stagnation, ventilation, and recirculation have come to be used to indicate special types of flow conditions that produce important effects on the dispersion of air pollutants. Stagnations are events where atmospheric flows decrease in speed, or stop altogether, allowing pollutants to build up in stagnant air in the vicinity of the pollutant sources. Ventilations, on the other hand, are events in which a confined polluted air mass is driven away and replaced by fresh air. Finally, a recirculation is an event in which polluted air is initially carried away from the source region but later returns to produce a high pollution episode. The three terms, when used in air pollution work, are often used in a general sense, but rarely are defined mathematically to allow a numerical evaluation of the flow character. In the present work we develop mathematical definitions of these terms by focusing directly on the relevant atmospheric transport conditions, irrespective of pollution levels. The mathematical definitions of several single-station integral quantities representative of stagnation, ventilation, and recirculation are described, and the approach is applied to a wind data set from a radar profiler at Page, Arizona. DOE

N93-17178# Kansas State Univ., Manhattan. Dept. of Agronomy.
RANGELAND: PLANT RESPONSES TO ELEVATED CO2
C. E. Owensby, P. I. Coyne, J. M. Ham, W. Parton, C. Rice, L. M. Auen, and N. Adam 1992 38 p
(Contract DE-FG02-84ER-60253)
(DE93-000883; DOE/ER-60253/T5) Avail: CASI HC A03/MF A01

Several broad conclusions which can be drawn from the work that was accomplished during the first 3-year phase of the study is described. In prairie ecosystems dominated by C4 grasses, it is likely that elevated atmospheric CO2 will increase ecosystem level productivity, with a greater increase in belowground productivity. The increased productivity will primarily result from increased water use efficiency due to the anti-transpirant action of CO2. Fumigation chambers are directly confounded with elevated CO2 effects, in that both reduce evapotranspiration. The reduced evapotranspiration of the fumigation chamber is primarily through reduced wind speeds and reduced radiation. In very dry years, fumigation chamber effects are negligible, but in years with normal precipitation, chamber effects and elevated CO2 effects are essentially equal with respect to reduced evapotranspiration effects. Increased production under elevated CO2 results in reduced nitrogen concentration in the herbage and increased fiber concentrations. Consequently, digestibility of the herbage is reduced, and microbial degradation of surface litter and soil organic matter is slowed. On the negative side, ruminant productivity will likely be reduced substantially, but increased carbon storage in the soil may buffer against future rise in atmospheric CO2. Tallgrass prairie will not likely change greatly in botanical composition, since the C4 dominants responded to elevated CO2 more than the C3 subdominants. DOE

N93-17197# Oak Ridge National Lab., TN.
SOIL ORGANIC MATTER DYNAMICS AND THE GLOBAL CARBON CYCLE
W. M. Post, W. R. Emanuel, and A. W. King 1992 17 p Presented at the International Workshop on World Inventory, Wageningen (Netherlands), 24-27 Aug. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001367; CONF-9208167-1) Avail: CASI HC A03/MF A01

The large size and potentially long residence time of the soil organic matter pool make it an important component of the global carbon cycle. Net terrestrial primary production of about 60 Pg(C/yr) is, over a several-year period of time, balanced by an equivalent flux of litter production and subsequent decomposition of detritus and soil organic matter. We review many of the major factors that influence soil organic matter dynamics that need to be explicitly considered in development of global estimates of carbon turnover in the world's soils. We also discuss current decomposition models that are general enough to be used to develop a representation of global soil organic matter dynamics. DOE

N93-17209# Oak Ridge National Lab., TN.
GLOBAL CLIMATE CHANGE: SOME IMPLICATIONS, OPPORTUNITIES, AND CHALLENGES FOR US FORESTRY
G. Marland 1991 16 p Presented at the 21st Southern Forest Tree Improvement Conference, Knoxville, TN, 17-20 Jun. 1991
(Contract DE-AC05-84OR-21400)
(DE92-040874; CONF-9106396-1) Avail: CASI HC A03/MF A01

It is widely agreed that the concentration of greenhouse gases in the earth's atmosphere is increasing, that this increase is a consequence of man's activities, and that there is significant risk that this will lead to changes in the earth's climate. The question is now being discussed what, if anything, we should be doing to minimize and/or adapt to changes in climate. Virtually every statement on this matter, from the US Office of Technology Assessment, to the National Academy of Science, to the Nairobi Declaration on Climatic Change, includes some recommendation for planting and protecting forests. In fact, forestry is intimately involved in the climate change debate for several reasons: changing climate patterns will affect existing forests, tropical deforestation is one of the major sources of greenhouse gases to the atmosphere, reforestation projects could remove additional carbon dioxide from the atmosphere, and there is renewed interest in wood-based or other renewable fuels to replace fossil fuels. Part of the enthusiasm for forestry-related strategies in a greenhouse context is the perception that forests not only provide greenhouse benefits but also serve other desirable social objectives. This discussion will explore the current range of thinking in this area and try to stimulate additional thinking on the rationality of the forestry-based approaches and the challenges posed for US forestry. DOE

N93-17211# Lawrence Livermore National Lab., CA.
EFFECTS OF THE MOUNT PINATUBO ERUPTION ON THE CHEMISTRY, RADIATIVE, AND TRANSPORT PROCESSES IN THE STRATOSPHERE
D. J. Wuebbles, D. E. Kinnison, K. E. Grant, and P. S. Connell Sep. 1992 10 p Presented at the 73d American Meteorological Society Annual Meeting, Anaheim, CA, 17-22 Jan. 1993
(Contract W-7405-eng-48)
(DE93-001508; UCRL-JC-111848; CONF-930133-3) Avail: CASI HC A02/MF A01

Volcanic eruptions can significantly impact trace gas distribution in the upper troposphere and lower stratosphere. Massive eruptions, produce large quantities of SO2, H2O, chlorine compounds, and particulates. Modeling the effects of these impulsive increases in traces gases and comparing the results with observations from ground and satellite measurements provide unique opportunities to test current multi-dimensional chemical-radiative-transport models of the global atmosphere. Since these models are currently being used in assessment studies for future anthropogenic emissions of trace gases quantitative understanding of the accuracy of these models is essential. In this study, we have used observed data from the Stratospheric Aerosol and Gas Experiment 2 (SAGE 2)

aboard the Earth Radiation Budget Satellite (ERBS) to realistically represent both the time dependent change in aerosol surface area density and wavelength dependent extinction values from the Mt. Pinatubo Eruption. Increases in the aerosol loading increase the rate of important heterogeneous chemical reactions converting odd nitrogen in both ClONO2 and N2O5 to HNO3. Radiative effects of increases aerosol optical thickness include changes to net radiative heating rates and to actinic fluxes. Changes to heating rates will indirectly change chemical reaction rates via changes in atmospheric temperatures. changes in actinic fluxes will directly modify photodissociation rates. DOE

N93-17344# Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Ecologia.

CARBON EMISSIONS AND SEQUESTRATION IN FORESTS: CASE STUDIES FROM SEVEN DEVELOPING COUNTRIES. VOLUME 4: CARBON EMISSIONS FROM DEFORESTATION IN MEXICO: CURRENT SITUATION AND LONG-TERM SCENARIOS

Omar Masera Cerutti, Maria deJesus Ordonez, Rodolfo Dirzo Minjarez, Willy Makundi, ed. (California Univ., Berkeley. Lawrence Berkeley Lab.), and Jayant Sathaye, ed. (California Univ., Berkeley. Lawrence Berkeley Lab.) Aug. 1992 55 p Presented at the Meeting of the Intergovernmental Panel on Climate Change, Sao Paulo, Brazil, Jan. 1990; sponsored by LBL, Sao Paulo Univ., and EPA

(Contract DE-AC03-76SF-00098)

(DE93-001599; LBL-32665-Vol-4) Avail: CASI HC A04/MF A01

Estimates of carbon emissions from deforestation in Mexico are derived for the year 1985 and for two contrasting scenarios in 2025. Carbon emissions are calculated through an in-depth review of the existing information on forest cover deforestation rates and area affected by forest fires as well as on forests' carbon-related biological characteristics. The analysis covers both tropical (evergreen and deciduous) and temperate (coniferous and broadleaf) closed forests. Emissions from the forest sector are also compared to those from energy and industry. Different policy options for promoting the sustainable management of forest resources in the country are discussed. The analysis indicates that approx. 804,000 hectares per year of closed forests suffered from major perturbations in the mid 1980's in Mexico, leading to an annual deforestation rate of 668,000 hectares. Seventy five percent of total deforestation is concentrated in tropical forests. The resulting annual carbon balance is estimated in 53.4 million tons/year, and the net committed emissions in 45.5 million tons or 41 and 38 pcts, respectively, of the country's total for 1985 to 87. The annual carbon balance from the forest sector in 2025 is expected to decline to 16.5 million tons in the low emissions scenario and to 22.9 million tons in the high emissions scenario. Because of the large uncertainties in some of the primary sources of information, the stated figures should be taken as preliminary estimates. DOE

N93-17352# Oak Ridge National Lab., TN.

ENVIRONMENTAL QUALITY INFORMATION ANALYSIS CENTER MULTI-YEAR PLAN

Rafael G. Rivera (RDG, Inc., Oak Ridge, TN.), Sujit Das, and Thomas E. Walsh (Florida Univ., Gainesville.) Sep. 1992 85 p

(Contract DE-AC05-84OR-21400)

(DE92-040850; ORNL/TM-12098) Avail: CASI HC A05/MF A01

An information analysis center (IAC) is a federal resource that provides technical information for a specific technology field. An IAC links an expert technical staff with an experienced information specialist group, supported by in-house or external data bases to provide technical information and maintain a corporate knowledge in a technical area. An IAC promotes the rapid transfer of technology among its users and provides assistance in adopting new technology and predicting and assessing emerging technology. This document outlines the concept, requirements, and proposed development of an Environmental Quality IAC (EQIAC). An EQIAC network is composed of several nodes, each of which has specific technology capabilities. This document outlines strategic and operational objectives for the phased development of one such node of an EQIAC network. DOE

N93-17370# Pacific Northwest Lab., Richland, WA.

MODELING THE UNCERTAIN IMPACTS OF CLIMATE CHANGE

A. M. Liebetrau Aug. 1992 3 p Presented at the 3rd International Environmetrics Society Conference, Espoo, Finland, 17-21 Aug. 1992

(Contract DE-AC06-76RL-01830)

(DE92-041339; PNL-SA-20951; CONF-9208149-1) Avail: CASI HC A01/MF A01

Human and earth systems are extremely complex processes. The modeling of these systems to assess the effects of climate change is an activity fraught with uncertainty. System models typically involve the linking of a series of computer codes, each of which is a detailed model of some physical or social process in its own right. In such system models, the output from one process model is the input to another. Traditional methods for dealing with uncertainty are inadequate because of the sheer complexity of the modeling effort; Monte Carlo methods and the exhaustive evaluation of 'what if?' scenarios estimate sensitivities fail because of the heavy computational burden. More efficient methods are required for learning about system models that are constructed from a collection of computer codes. A two-tiered modeling approach is being developed to estimate the distribution of outcomes from a series of nested models. The basic strategy is to develop a simplified executive, or simplified system code (SSC), that is analogous to the more complex underlying code. An essential feature of the SSC is that it uses information abstracted from the detailed underlying process codes in a manner that preserves their essential features and interactions among them. Of course, to be useful, the SSC must be much faster to run than its complex counterpart. The success of the SSC modeling strategy depends on the methods used to extract essential features of the complex underlying codes. DOE

N93-17470# Pennsylvania State Univ., University Park. Dept. of Chemistry.

RADON: CHEMICAL AND PHYSICAL PROCESSES ASSOCIATED WITH ITS DISTRIBUTION

A. W. Castleman, Jr. 1992 5 p

(Contract DE-FG02-88ER-60668)

(DE93-003718; DOE/ER-60668/5) Avail: CASI HC A01/MF A01

Assessing the mechanisms which govern the distribution, fate, and pathways of entry into biological systems, as well as the ultimate hazards associated with the radon progeny and their secondary reaction products, depends on knowledge of their chemistry. Our studies are directed toward developing fundamental information which will provide a basis for modeling studies that are requisite in obtaining a complete picture of growth, attachment to aerosols, and transport to the bioreceptor and ultimate incorporation within. Our program is divided into three major areas of research. These include measurement of the determination of their mobilities; study of the role of radon progeny ions in affecting reactions, including study of the influence of the degree of solvation (clustering); and examination of the important secondary reaction products, with particular attention to processes leading to chemical conversion of either the core ions or the ligands as a function of the degree of clustering. DOE

N93-17474# Argonne National Lab., IL.

GLOBAL ENVIRONMENTAL SECURITY: RESEARCH AND POLICY STRATEGIES FOR THE 1990S

M. A. Lazaro and Hua Wang 1992 10 p Presented at the International Symposium on Energy, Environment and Information Management, Argonne, IL, 15-18 Sep. 1992

(Contract W-31-109-eng-38)

(DE92-040095; ANL/CP-77199; CONF-9209160-11) Avail: CASI HC A02/MF A01

The subject of global environmental change is emerging as one of the most hotly debated international issues for the 1990s. In fact, our earth system has undergone a nature-induced gradual change in climate on both a temporal scale that spans over millions of years and a spatial scale ranging from regional to transcontinental. Pollutant emissions associated with population growth and industrial activities manifest the anthropogenic climatic forcing that has been superimposed on the background of natural climate fluctuations. Our incomplete understanding of the global impacts of environmental pollution on the earth systems (atmosphere, biosphere, hydrosphere, cryosphere, and lithosphere), however, make the prediction of the timing, magnitude, and patterns of future global change uncertain. This paper examines the science and policy background of global environmental change. The major scientific uncertainties and policy issues confronting decision makers are identified; and the scientific framework, as well as current national and international research programs aimed at resolving the scientific uncertainties, are discussed. A coherent,

stable, and flexible policy is needed to provide a foundation for coordinated international-interagency programs of observation, research, analysis, and international negotiation toward a policy consensus concerning global environmental security. On the basis of what is currently known about global change, recommendations are presented on both near-term and long-term policy option decisions. DOE

N93-17478# Oak Ridge National Lab., TN.
MODELING SOCIOECONOMIC AND ECOLOGIC ASPECTS OF LAND-USE CHANGE
V. H. Dale, M. A. Pedlowski, R. V. ONeill, and F. Southworth 1992 7 p Presented at the Forest 1992 Second International Symposium on Enrironmental Studies of Tropical Rain Forests, Rio de Janeiro, Brazil, 24-29 May 1992
(Contract DE-AC05-84OR-21400)
(DE93-001370; CONF-9205261-1) Avail: CASI HC A02/MF A01

Land use change is one of the major factors affecting global environmental conditions. Prevalent types of land-use change include replacing forests with agriculture, mines, or ranches; forest degradation from collection of firewood; and forest logging. A global effect of wide-scale deforestation is an increase in atmospheric carbon dioxide concentration, which may affect climate. Regional effects include loss of biodiversity and disruption of hydrologic regimes. Local effects include soil erosion, siltation and decreases in soil fertility, loss of extractive reserves, and disruption of indigenous people. Modeling land use change requires combining socioeconomic and ecological factors because socioeconomic forces frequently initiate land-use change and are affected by the subsequent ecological degradation. A modeling system that integrates submodels of human colonization and impacts to estimate patterns and rates of deforestation under different immigration and land use scenarios is described. Immigration which follows road building or paving is a major factor in the rapid deforestation of previously inaccessible areas. Roads facilitate colonization, allow access for large machines, and provide transportation routes for export of raw materials and produce. DOE

N93-17496# Oak Ridge National Lab., TN.
THE GLOBAL HISTORICAL CLIMATOLOGY NETWORK: LONG-TERM MONTHLY TEMPERATURE, PRECIPITATION, AND PRESSURE DATA
R. S. Vose, R. L. Schmoyer, T. C. Peterson, P. M. Steurer, R. R. Heim, Jr., T. R. Karl (National Climatic Data Center, Asheville, NC.), and J. K. Eischeid (Colorado Univ., Boulder.) 1992 7 p Presented at the 73rd AMS Annual Meeting, Anaheim, CA, 17-22 Jan. 1993
(Contract DE-AC05-84OR-21400)
(DE92-041261; CONF-930133-2) Avail: CASI HC A02/MF A01

Interest in global climate change has risen dramatically during the past several decades. In a similar fashion, the number of data sets available to study global change has also increased. Unfortunately, many different organizations and researchers have compiled these data sets, making it confusing and time consuming for individuals to acquire the most comprehensive data. In response to this rapid growth in the number of global data sets, DOE's Carbon Dioxide Information Analysis Center (CDIAC) and NOAA's National Climatic Data Center (NCDC) established the Global Historical Climatology Network (GHCN) project. The purpose of this project is to compile an improved data set of long-term monthly mean temperature, precipitation, sea level pressure, and station pressure for as dense a network of global stations as possible. Specifically, the GHCN project seeks to consolidate the numerous preexisting national-, regional-, and global-scale data sets into a single global data base; to subject the data to rigorous quality control; and to update, enhance, and distribute the data set at regular intervals. The purpose of this paper is to describe the compilation and contents of the GHCN data base (i.e., GHCN Version 1.0). DOE

N93-17532# East Anglia Univ., Norwich (England). Climatic Research Unit.
DETECTION OF GREENHOUSE-GAS-INDUCED CLIMATIC CHANGE
T. M. L. Wigley and P. D. Jones 15 Jul. 1992 25 p
(Contract DE-FG02-86ER-60397)
(DE93-003149; DOE/ER-60397/6) Avail: CASI HC A03/MF A01

The aims of the US Department of Energy's Carbon Dioxide Research Program are to improve assessments of greenhouse-gas-induced climatic change and to define and reduce uncertainties through selected research. This project addresses the following: the regional and seasonal details of the expected climatic changes; how rapidly these changes occur; how and when the climatic effects of CO2 and other greenhouse gases be first detected; and the relationships between greenhouse-gas-induced climatic change and changes caused by other external and internal factors. Many of the diverse facets of greenhouse-gas-related climate research can be grouped under three interlinked subject areas: modeling, first detection, and supporting data. This project includes the analysis of climate forcing factors, the development and refinement of transient response climate models, and the use of instrumental data in validating General Circulation Models (GCM's). DOE

N93-17576# California Univ., Berkeley. Lawrence Berkeley Lab.
INDOOR OZONE CONCENTRATIONS: VENTILATION RATE IMPACTS AND MECHANISMS OF OUTDOOR CONCENTRATION ATTENUATION
J. A. Cano-Ruiz, M. P. Modera, and W. W. Nazaroff Jul. 1992 20 p Presented at the 13th Air Infiltration and Ventilation Conference: Ventilation for Energy Efficiency and Optimum Indoor Air Quality, Nice, France, 15-18 Sep. 1992
(Contract DE-AC03-76SF-00098)
(DE93-000633; LBL-32639; CONF-9209236-1) Avail: CASI HC A03/MF A01

The classification of outdoor (ambient) air as fresh for the purposes of ventilation is not always appropriate, particularly in urban areas. In many cities of the world, urban air frequently violates health-based air quality standards due to high ozone concentrations. The degree of protection from exposure to ozone offered by the indoor environment depends on the relationship between indoor and outdoor ozone levels. Existing concentration data indicates that indoor/outdoor ozone ratios range between 10 and 80 percent. This paper analyzes several of the key issues influencing indoor ozone concentrations, including: (1) the degree of penetration of outdoor ozone indoors; (2) removal within the indoor environment (removal at surfaces and within air distribution systems); and (3) the correlation in time between outdoor ozone levels and ventilation rates. A model for calculating the degree of ozone removal in typical building leaks and air distribution systems is described and applied to a range of typical cases. This model indicates that the degree of removal is minimal for most wooden building cracks, but could be significant in leaks in concrete or brick structures, and is strongly dependent on the lining material for air distribution systems. Indoor ozone exposure estimates based on hourly outdoor ozone monitoring data and hour-by-hour weather-based simulations of infiltration rates and building operation are reported for a few residential scenarios. These estimates serve as a basis for exploring the impact of energy-efficient ventilation strategies on indoor ozone exposures. DOE

N93-17663# Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
ENVIRONMENTAL IMPACT RESEARCH PROGRAM AND DEFENSE NATURAL RESOURCES PROGRAM: MAXIMILIAN SUNFLOWER (HELIANTHUS MAXIMILIANI), SECTION 7.4.3, US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL Final Report
Donald R. Dietz, Clinton H. Wasser, Phillip L. Dittberner, and Chester O. Martin Feb. 1992 29 p
(AD-A257478; WES/TR/EL-92-16) Avail: CASI HC A03/MF A01

A plant materials report on Maximilian sunflower (Helianthus maximiliani) is provided as Section 7.4.3 of the US Army Corps of Engineers Wildlife Resources Management Manual. The report was prepared as a guide to assist the project biologist/natural resources manager with the selection, establishment, and management of appropriate plant materials for wildlife and habitat development programs. Major topics covered are description, distribution, habitat requirements, wildlife value, establishment, maintenance, and cautions and limitations. Maximilian sunflower is a perennial forb native to the tall- and mixed-grass prairie region of the central United States and south-central Canada. The sunflower is known to provide food and cover for a variety of wildlife species, especially nongame birds. The species is also used for soil stabilization an site reclamation, and the showy yellow flowers make it popular for landscaping. Two cultivars are presently available for use in conservation plantings. The species grows best on medium sandy to clayey loams on sites that receive more than 14 in. (36 cm) of annual precipitation. Plants are tolerant of fire and moderately tolerant of drought and shade, but are unable to withstand saline soils and heavy grazing. Established plants are highly competitive unless management

practices are employed to reduce their vigor. This report provides specifications for site selection and preparation, propagule selection, planting, and maintenance of Maximilian sunflower to improve wildlife habitat conditions within its region of greatest management use. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N93-15994# Naval Postgraduate School, Monterey, CA.
THE ATMOSPHERIC EMISSION METHOD OF CALCULATING THE NEUTRAL ATMOSPHERE AND CHARGED PARTICLE DENSITIES IN THE UPPER ATMOSPHERE M.S. Thesis
Kenneth L. McElroy, Jr. Dec. 1992 87 p
(AD-A257341) Avail: CASI HC A05/MF A01

A method is presented for the determination of neutral gas densities in the ionosphere from rocket-borne measurements of UV atmospheric emissions. Computer models were used to calculate an initial guess for the neutral atmosphere. Using this neutral atmosphere, intensity profiles for the N2 (0,5) Vegard-Kaplan band, the N2 Lyman-Birge-Hopfield band system, and the OI2972 A line were calculated and compared with the March 1990 NPS MUSTANG data. The neutral atmospheric model was modified and the intensity profiles recalculated until a fit with the data was obtained. The neutral atmosphere corresponding to the intensity profile that fit the data was assumed to be the atmospheric composition prevailing at the time of the observation. The ion densities were then calculated from the neutral atmosphere using a photochemical model. The electron density profile calculated by this model was compared with the electron density profile measured by the U.S. Air Force Geophysics Laboratory at a nearby site. GRA

N93-16017# Phillips Lab., Hanscom AFB, MA.
A PROPOSED GAS RELEASE EXPERIMENT ON THE ARGOS SATELLITE Interim Report
Shu T. Lai, Edmond Murad, and C. P. Pike 29 Jan. 1992 42 p
(AF Proj. 7601)
(AD-A256182; AD-E201197; PL-TR-92-2058; ERP-1098) Avail: CASI HC A03/MF A01

Release of xenon and carbon dioxide gases from nozzles on the Advanced Research and Global Observation Satellite (ARGOS) orbiting with a velocity of about 7.4 km/s at an altitude of about 800 km is proposed. The releases will be conducted mostly in darkness over the Maui telescope site. The vector sum of the satellite and gas velocities will exceed the velocity requirement for the critical ionization velocity (CIV) process of xenon. It is feasible that the xenon gas will achieve critical velocity ionization. Associative ionization and collisional stripping will not occur for the xenon gas and there is no photo-ionization in darkness; ionization processes competing with CIV are absent. Neutral density, ambient magnetic field, and seed ionization effects on the xenon gas CIV will be discussed. Unlike xenon, carbon dioxide will not undergo CIV because of its higher velocity requirement. However, it is feasible that carbon dioxide colliding with the atmospheric species will form excited CO and OH molecules, which will radiate subsequently. Optical, IR, and UV observations on the satellite and at Maui will provide diagnostic measurements for the experiment. GRA

N93-16093# California Univ., Berkeley. Seismographic Station.
SCATTERING OF ELASTIC WAVES BY A SPHERICAL INCLUSION Report No. 1
Valeri A. Korneev and Lane R. Johnson 28 Apr. 1992 76 p
(Contract F19628-90-K-0055)
(AD-A256676; PL-TR-92-2124; AD-E201178) Avail: CASI HC A05/MF A01

A complete and exact solution for the problem of an incident P wave scattered by an elastic spherical inclusion is presented and described. The solution can be obtained from either analytical formulas or stable numerical procedures. A method of estimating the number of terms that must be retained in the harmonic series in order to achieve a specified accuracy is given. The results are investigated by calculating synthetic seismograms, scattering diagrams, and scattering cross sections for a broad frequency band and for both low-velocity and high-velocity inclusions. The fields within the shadow zone are formed primarily from three different types of waves, P waves transmitted through the sphere, P waves diffracted around the sphere, and S waves converted at the boundary of the sphere. Starting with the exact solution for the scattering of a plane P wave by a homogeneous spherical inclusion, various types of approximate solutions are developed and discussed. The standard Rayleigh and Mie approximations are extended to the case of inclusions having arbitrary contrasts in material properties. For the low contrast case, solutions are developed which are valid over a wide frequency range. Several aspects of these solutions are discussed, including the importance of near-field terms and the relative strength of the scattered P and S fields. The various types of approximate solutions are compared with each other and with the exact solution by calculating and displaying their normalized scattering cross sections. GRA

N93-16094# Nevada Univ., Reno.
REGIONAL SEISMIC STUDIES IN CENTRAL ASIA Report No. 1, 1 Aug. 1990 - 31 Aug. 1991
Keith Priestley 5 May 1992 88 p
(Contract F19628-90-K-0046)
(AD-A256677; PL-TR-92-2127; AD-E201198) Avail: CASI HC A05/MF A01

The preliminary analysis is described of the 2400 km long western Norilsk-Lake Baikal deep seismic sounding profile. Seismograms for the three nuclear explosions have been digitized, corrected for gain changes, and record sections constructed. These data have been compared with travel times predicted from several existing velocity models for Eurasia and modelling the data has begun. A study is also discribed of the tectonics of the South Caspian region. Earthquake mechanisms show overthrusting of the South Caspian basin from the north, west, and south. The combined effect will lead to the eventual destruction of the South Caspian basin and the possible formation of an intermediate depth seismic zone within the continental interior similar to the Hindu Kush. GRA

N93-16138# Phillips Lab., Hanscom AFB, MA.
PROCEEDINGS OF THE FOURTEENTH ANNUAL PL/DARPA SEISMIC RESEARCH SYMPOSIUM Final Report
James F. Lewkowicz and Jeanne M. McPhetres 17 Aug. 1992 486 p
Proceedings held in Tucson, AZ, 16-18 Sep. 1992
(AD-A256711; AD-E201220; PL-TR-92-2210; ERP-1106) Avail: CASI HC A21/MF A04

Partial contents of papers presented include: A Generalized Likelihood Ratio Test in Outlier Detection or Script Matching; Analysis of Regional Bodywave Phases from Earthquakes in West China; Numerical Models of Quarry Blast Sources; Regional Seismic Event Discriminants -- What Works, What Doesn't and Why; Seismic Discrimination of Rockbursts in Mines; Deep Seismic Soundings in Northern Eurasia -- Interpretation of the Murmansk-Kizil Ultra-Long-Range Profile; Non-Linear Attenuation in the Near Source Region -- Characterization of Hysteresis in the Deformationof Rock Joints; Epicentral Azimuth Determination by Mini Array Processing; Source Function Deconvolution of Delay-Fired Explosions and Earthquakes at Regional Distances; Regional Wave Attenuation in Eurasia; Effects of an Irregular Free Surface and Moho on Regional Wave Propagation; Global Seismic Evidence Combination; Generalized Ray/Born Synthesis of Complete Regional Seismograms in Three-Dimensional Crustal Models; An X-Windows Graphics Tool to Compute Synthetic Seismograms for 2-D Models Using Gaussian Beams; Seismic Array Study of the Baikal Rift Zone, Siberia; Numerical Simulation of Nonlinear Attenuation Using an Endochronic Formulation; Applications of Array Spectral Factorization Methods to Regional Seismic Discrimination and Three-Component Processing; A Network-Accessible Geological and Geophysical Database for Eurasia; Multivariate Seismic Calibration for the Novaya Zemlya Test Site;and Ground-Truth Data for Seismic Discrimination Research. GRA

N93-16143# Army Lab. Command, White Sands Missile Range, NM. Atmospheric Sciences Lab.
VERTICAL MOLECULAR ABSORPTION COEFFICIENT PROFILES AND ASSOCIATED METEOROLOGICAL DATA AT THE HIGH ENERGY LASER SYSTEMS TEST FACILITY FOR 20 AUGUST 1991 Final Report
Frank T. Kantrowitz Sep. 1992 28 p
(AD-A257353; ASL-TMR-0013) Avail: CASI HC A03/MF A01

In support of White Sands Missile Range high energy laser operations for 20 August 1991, the U.S. Army Atmospheric Sciences Laboratory was tasked to calculate simulated molecular absorption coefficient vertical profiles by using the U.S. Air Force Phillips Laboratory Geophysics Directorate (formerly the U.S. Air Force Geophysics Laboratory) transmittance and radiance program FASCOD2. GRA

N93-16155# Lockheed Missiles and Space Co., Palo Alto, CA. Research Lab.

INVESTIGATION OF RING CURRENT/STORM DYNAMICS: PRELIMINARY RESULTS

H. L. Collin, J. B. Cladis, and J. M. Quinn 30 Jun. 1992 38 p

(Contract F19628-90-C-0119)

(AD-A256704; PL-TR-92-2161; AD-E201227; SR-2) Avail: CASI HC A03/MF A01

This study outlines the achievements of the second year of work on data acquired by the Lockheed Ion Mass Spectrometer (IMS-LO), one of the space radiation group of instruments on the Combined Release and Radiation Effects Satellite (CRRES). The purpose of IMS-LO is to study the low energy (110 eV to 35 keV) ion component of the current plasma. The primary data processing is almost complete, as is the construction of databases of validated low energy ion data. A preliminary version of a static model of low energy ion composition in the ring current has been constructed. This shows the average equatorial energy and pitch-angle distributions of ion fluxes organized by L and local time. Non-equatorial distributions can be obtained by adiabatic mapping. A number of events from both quiet and disturbed times have been selected for special studies. The quiet time convection electric field was estimated using the Liouville's Theorem method. Several events were studied which suggest that induced electric fields can be important in the acceleration and loss of ions. GRA

N93-16171# Michigan Univ., Ann Arbor. Space Physics Research Lab.

REMOTE MEASUREMENT OF UPPER ATMOSPHERIC DENSITY: INSTRUMENT DEFINITION Final Report, Jul. 1988 - Oct. 1991

P. B. Hays, J. H. Yee, and V. J. Abreu 3 Dec. 1991 86 p

(Contract F19628-88-K-0032)

(AD-A256714; PL-TR-92-2003; AD-E201222) Avail: CASI HC A05/MF A01

A study conducted previously at the Space Physics Research Laboratory, University of Michigan (Hays et al., 1988) has concluded that measurement of the spectral intensity of the O2 atmospheric band is the most feasible technique. The basic determination of the temperature can be accomplished using the optically thin transition from O2(Sigma1) to O2(Sigma3) in the (0-1) band; here local atmospheric temperature is determined uniquely by the rotational development of the emission band since the band is in the thermal dynamic equilibrium. The density of molecular oxygen is determined from the (0-0) band of the same system; here self absorption by molecular oxygen is responsible for a reduction in intensity of the stronger lines in the system. This remote sensing technique has been proven to be feasible by rocket spectroscopic measurements during this funding period. This report describes the remote sensing techniques and the optical instrument used. The results obtained from the rocket experiment are presented with evaluation of the magnitude of all the possible sources of error. A conceptual design of the instrument to implement this remote sensing technique from a satellite platform is also prepared which identifies the major hardware elements required. GRA

N93-16173# Boston Coll., Chestnut Hill, MA.

THE EARTH'S RADIATION BELTS, AURORAL ZONES, AND POLAR CAPS: PARTICLE MODELS, EVENT STUDIES, AND EFFECTS ON MATERIALS Final Report, 30 Apr. 1987 - 31 Dec. 1991

R. L. Carovillano 16 Apr. 1992 172 p

(Contract F19628-86-C-0029)

(AD-A256716; PL-TR-92-2126; AD-E201225) Avail: CASI HC A08/MF A02

Some research activities are as follows. (1) An empirical DMSP data base of the most poleward ion precipitation boundary: The data base was analyzed statistically and analytically. At each MLT there is great variance, and the ion boundary correlates best with AE. The average boundary is a circle offset from the geomagnetic pole that expands with geomagnetic activity. (2) An analytical model of convection and currents in the height-integrated ionosphere coupled to field aligned currents: Results include the effect of auroral conductivity; the deterministic coupling between Region 1 and Region 2 currents; the generation of auroral electrojet currents; the electrical shielding of low latitudes; two cell and multiple cell convection patterns; and conductivity gradient effects. (3) Energy dispersion discovered at the ion polar cap boundary: Interpretations have the ions originating in the plasma sheet boundary layer. (4) Various tasks and services with Air Force data bases: Tasks included particle event studies, the auroral boundary index, the polar rain index, and several CRRES projects including the static radiation belt model. Services included algorithm development, provision for data storage, access, and documentation. GRA

N93-16221# Beleidscommissie Remote Sensing, Delft (Netherlands).

OBSERVATION OF THE EARTH-ATMOSPHERE SYSTEM BY NOAA SATELLITE (ACQUISITION, PRODUCTION, APPLICATION, AND USE OF NOAA DATA) [OBSERVATIE VAN HET AARD-ATMOSFEERSYSTEEM DOOR DE NOAA-SATELLIETEN (ONTVANGST, PRODUCTIE, TOEPASSING EN GEBRUIK VAN DE NOAA-DATA)]

J. N. Roozekrans (Royal Netherlands Meteorological Inst., De Bilt.) and G. J. Prangsma (Royal Netherlands Meteorological Inst., De Bilt.) Mar. 1992 128 p In DUTCH

(BCRS Proj. IS-3.5; BCRS Proj. OP-1.12)

(BCRS-92-02; ISBN-90-5411-034-1; ETN-93-92847) Avail: CASI HC A07/MF A02

Two projects of the Netherlands national remote sensing program are described. Background information about the NOAA satellite system is given. The infrastructure (hardware and software) for the reception and processing of NOAA data at the Royal Dutch Meteorological Institute is outlined. The data processing, products, applications, and use of TOVS (Tiros Operational Vertical Sounder) and AVHRR (Advanced Very High Resolution Radiometer) are described, with a view to meteorology and climatology. ESA

N93-16264# Naval Postgraduate School, Monterey, CA.

KINK-ASSISTED MODE HOPPING IN A SURFACE WAVE RESONATOR M.S. Thesis

Charles B. McClellan Jun. 1992 68 p

(AD-A256314) Avail: CASI HC A04/MF A01

Self-localized kink structures have been observed in standing surface gravity waves in a parametrically driven annular channel of liquid. The kink regions have substantially greater amplitude and smaller wavelength than the extended mode region, and can exist indefinitely only for sufficiently large drive levels such that the structures exhibit violent breaking and jetting motion. For lower drive levels, the structures exist as transients that spontaneously participate in the transition from one mode to a mode with either one less or one more wavelength. In this mode hopping process, the destruction or creation of the wavelength occurs in the kink region. The kink structures are predicted to exist according to a theory that simultaneously allows amplitude and wave number modulations of a finite-amplitude standing wave. This situation is in fundamental contrast to nonlinear Schrodinger solitons, which correspond to only amplitude modulations, and to all other known types of solitons. GRA

N93-16461*# Science Applications International Corp., McLean, VA.

EXPERIMENTER'S DATA PACKAGE FOR THE DESCENDING LAYERS ROCKET

Greg Earle, Fred Herrero (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.), John Foster (Millstone Hill Radar Observatory, Westford, MA.), Mike Buonsanto (Millstone Hill Radar Observatory, Westford, MA.), and P. Satya-Narayana 9 Sep. 1992 21 p Presented at the Project Initiation Conference, Wallops Island, VA, 9 Sep. 1992

(NASA-TM-108591; NAS 1.15:108591) Avail: CASI HC A03/MF A01

In response to a proposal from Science Applications International Corporation (SAIC), NASA Headquarters has approved a sounding rocket mission designed to study the physics of intermediate layers in the Earth's ionosphere at middle latitudes. The experiment will be carried out by a team of scientists and engineers from the NASA Wallops Flight Facility, SAIC, the NASA Goddard Space Flight Center, and the Millstone Hill radar observatory. The mission will involve the launch of an instrumented sounding rocket from the Wallops Island rocket range in the summer of 1994, with the objective of penetrating a descending ionized layer in the E-region between altitudes of 115 and 140 km. Instrumentation aboard the rocket

will measure the ion and neutral composition of the layer, its plasma density, driving wind and electric field forces, the thermal ion distribution function, and electron temperature. Depending on payload weight constraints and subject to availability, a particle detector to measure energetic ion and/or electron fluxes near the layer may also be included. This document was prepared as a reference for the NASA payload development and experiment teams, for distribution at the Project Initiation Conference (PIC). The design specifications discussed herein are therefore of a preliminary nature; the intent is to promote open discussions between experimenters and NASA engineers that will lead to a final design capable of achieving the experiment objectives. Author

N93-16510# Leeds (David J.) and Associates, Los Angeles, CA.
STATE-OF-THE-ART FOR ASSESSING EARTHQUAKE HAZARDS IN THE UNITED STATES. REPORT 28: RECOMMENDED ACCELEROGRAMS FOR EARTHQUAKE GROUND MOTIONS
David L. Leeds Jun. 1992 453 p Sponsored by Army Engineer Waterways Experiment Station
(AD-A256276; WES/MP/S-S-73-1-28) Avail: CASI HC A20/MF A04

A catalog of recommended accelerograms and response spectra is provided to accompany all representative values for Richter magnitudes at distance determined peak horizontal accelerations-velocities-durations, hard and soft sites, and shallow and deep earthquakes. Accelerograms are also recommended for corresponding Modified Mercalli intensities. The accelerograms are related to the Krinitzsky-Chang-Nuttli curves for magnitude and distance, and the Krinitzsky-Chang curves for MM intensity. GRA

N93-16536*# Aerospace Corp., El Segundo, CA. Space Particles and Fields Dept.
INFERENCES CONCERNING THE MAGNETOSPHERIC SOURCE REGION FOR AURORAL BREAKUP
L. R. Lyons 17 Nov. 1992 10 p Repr. from Proceedings of the International Conference on Substorms (ICS-1), Kiruna (Sweden), 23-27 Mar. 1992 p 257-261
(Grants NAGw-2126; NSF ATM-88-00602; NSF ATM-88-00321)
(NASA-CR-191674; ATR-92(7186)-1; NAS 1.26:191674) Avail: CASI HC A02/MF A01

It is argued that the magnetospheric source region for auroral arc breakup and substorm initiation is along boundary plasma sheet (BPS) magnetic field lines. This source region lies beyond a distinct central plasma sheet (CPS) region and sufficiently far from the Earth that energetic ion motion violates the guiding center approximation (i.e., is chaotic). The source region is not constrained to any particular range of distances from the Earth, and substorm initiation may be possible over a wide range of distances from near synchronous orbit to the distant tail. It is also argued that the layer of low-energy electrons and velocity dispersed ion beams observed at low altitudes on Aureol 3 is not a different region from the region of auroral arcs. Both comprise the BPS. The two regions occasionally appear distinct at low altitudes because of the effects of arc field-aligned potential drops on precipitating particles. Author

N93-16683*# Michigan Univ., Ann Arbor. Dept. of Atmospheric, Oceanic and Space Sciences.
THERMOSPHERE-IONOSPHERE-MESOSPHERE ENERGETICS AND DYNAMICS (TIMED). THE TIMED MISSION AND SCIENCE PROGRAM REPORT OF THE SCIENCE DEFINITION TEAM. VOLUME 1: EXECUTIVE SUMMARY
Jul. 1991 30 p Original contains color illustrations
(Grant NAG5-1622)
(NASA-CR-191377; NAS 1.26:191377) Avail: CASI HC A03/MF A01; 2 functional color pages

A Science Definition Team was established in December 1990 by the Space Physics Division, NASA, to develop a satellite program to conduct research on the energetics, dynamics, and chemistry of the mesosphere and lower thermosphere/ionosphere. This two-volume publication describes the TIMED (Thermosphere-Ionosphere-Mesosphere, Energetics and Dynamics) mission and associated science program. The report outlines the scientific objectives of the mission, the program requirements, and the approach towards meeting these requirements. Author

N93-16718*# Nebraska Univ., Lincoln. Inst. of Agriculture and Natural Resources.
RADIATION FLUXES AT THE FIFE SITE Final Report, 1 Jan. 1991 - 31 Jul. 1992
Elizabeth A. Walter-Shea, Blaine L. Blad, Pedro Zara, Roel Vining, Cynthia J. Hays, and Mark A. Mesarch Jan. 1993 92 p
(Grant NAG5-894)
(NASA-CR-191717; NAS 1.26:191717; AgMet-93-1) Avail: CASI HC A05/MF A01

The main objective of the International Satellite Land Surface Climatology Project (ISLSCP) has been stated as 'the development of techniques that may be applied to satellite observations of the radiation reflected and emitted from the Earth to yield quantitative information concerning land surface climatological conditions'. The major field study, FIFE (the First ISLSCP Field Experiment), was conducted in 1987-89 to accomplish this objective. Four intensive field campaigns (IFC's) were carried out in 1987 and one in 1989. Factors contributing to observed reflected radiation from the FIFE site must be understood before the radiation observed by satellites can be used to quantify surface processes. Our last report (Walter-Shea et al., 1992b) focused on slope effects on incoming and outgoing shortwave radiation and net radiation from data collected in 1989. We report here on the final analysis of the slope data as well as results from thermal radiation studies conducted during the FIFE experiment. The specific areas reported are the following: (1) analysis of slope effects on measured reflectance values and estimates of surface albedo; (2) using remotely-measured surface temperatures as a means of estimating sensible heat flux from the Konza Prairie; (3) extracting canopy temperatures from remotely-measured composite surface temperatures; (4) modeling the measured composite temperature of partially vegetated surfaces; and (5) estimating gap distribution in partially vegetated surfaces from reflectance measurements. Author

N93-16744 Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
THE GRAVIMETRIC ANOMALY OVER THE MAKHTESH HAGADOL AND ITS VICINITY M.S. Thesis
Nachum Shenberg Mar. 1991 119 p In HEBREW
(ITN-93-85180) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

The Judea Group masks the deeper parts of the section, preventing their expression in the residual gravimetric anomaly. The Judea Group, which is truncated near the monocline axis near the Makhtesh HaGadol, would be expected to cause a gravity anomaly opposite to the actual one, namely high gravity over the syncline and low over the monocline axis. A monocline model is proposed, which considers the sandy Hatira formation--a monocline truncated at the axis, with a lower density than that of the surrounding Jurassic section--to be the source of the gravity anomaly. An alternative model is the 'monocline and horst model', in which there is a horst comprising pre-Jurassic formations bounded by thrust faults, below the Hatira monocline. The horst plays a secondary role in explaining a secondary positive gravity anomaly over the sloping flank of the monocline. The monoclines reflect shortening in depth by means of tilted blocks, owing to the Syrian Arc activity, while the horst is uniquely related to the Hatira structure. Similarities to other monoclines in the Negev indicate that the solution for the Hatira structure may apply to other structures also. The Syrian Arc structure was also studied for common structural characteristics, through an isostatic analysis. The inversion problem was solved using a specially written inversion program which applies an algorithm for solving a minimum problem with constraints by a non-linear optimization and direct-search method. ISA

N93-16839*# Lockheed Missiles and Space Co., Palo Alto, CA. Space Sciences Lab.
EFFECTS OF CONVECTION ELECTRIC FIELD ON UPWELLING AND ESCAPE OF IONOSPHERIC O(+) Final Report, 7 May 1991 - 7 Aug. 1992
J. B. Cladis, Yam T. Chiu, and William K. Peterson 7 Aug. 1992 25 p
(Contract NAS5-31211)
(NASA-CR-191669; NAS 1.26:191669) Avail: CASI HC A03/MF A01

A Monte Carlo code is used to explore the full effects of the convection electric field on distributions of upflowing O(+) ions from the cusp/cleft ionosphere. Trajectories of individual ions/neutrals are computed as they undergo multiple charge-exchange collisions. In the ion state, the trajectories

are computed in realistic models of the magnetic field and the convection, corotation, and ambipolar electric fields. The effects of ion-ion collisions are included, and the trajectories are computed with and without simultaneous stochastic heating perpendicular to the magnetic field by a realistic model of broadband, low frequency waves. In the neutral state, ballistic trajectories in the gravitational field are computed. The initial conditions of the ions, in addition to ambipolar electric field and the number densities and temperatures of O(+), H(+), and electrons as a function of height in the cusp/cleft region were obtained from the results of Gombosi and Killeen (1987), who used a hydrodynamic code to simulate the time-dependent frictional-heating effects in a magnetic tube during its motion though the convection throat. The distribution of the ion fluxes as a function of height are constructed from the case histories. Author

N93-16924# Wisconsin Univ., Madison. Space Science and Engineering Center.

HIGH SPECTRAL RESOLUTION MEASUREMENTS FOR THE ARM PROGRAM

H. E. Revercomb 22 May 1992 11 p

(Contract DE-FG02-90ER-61057)

(DE93-002772; DOE/ER-61057/2) Avail: CASI HC A03/MF A01

This report focuses on the design and fabrication of high spectral resolution FTIR (Fourier Transform Infrared) instrumentation for the CART sites of the Atmospheric Radiation Measurement (ARM) Program. The ultimate objective of this grant is to develop three different types of instruments, named the AERI, AERI-X, and SORT. The Atmospheric Emitted Radiance Interferometer (AERI) is the simplest. It will be available for early deployment at the first ARM site and will be deployable at several locations in the extended network to give horizontal coverage. The AERI will be a 0.5 cm(exp -1) resolution instrument, which measures accurately calibrated radiance spectra for radiation studies and for remote sensing of atmospheric state variables. The AERI-X and the SORTI are higher spectral resolution instruments for obtaining the highest practical resolution for spectroscopy at the ARM central sites. The AERI-X, like the AERI will measure atmospheric emitted radiance, but with resolutions as high as 0.1 cm(exp -1). The Solar Radiance Transmission Interferometer will measure the total transmission of the atmosphere by tracking the sun through changes in atmospheric air mass. The large solar signal makes it practical for this instrument to offer the ultimate in spectral resolution, about 0.002 cm(exp -1). DOE

N93-16938*# Victoria Univ., Wellington (New Zealand).

KINEMATICS OF THE NEW ZEALAND PLATE BOUNDARY: RELATIVE MOTION BY GPS ACROSS NETWORKS OF 1000 km AND 50 km SPACING Progress Report, 1 Apr. 1992 - 8 Jan. 1993

Charles M. Meertens, Christian Rocken, Barbara Perin, and Richard Walcott 8 Jan. 1993 29 p

(Grant NAG5-1957)

(NASA-CR-191714; NAS 1.26:191714) Avail: CASI HC A03/MF A01

The NASA/DOSE 'Kinematics of the New Zealand Plate Boundary' experiment is a four-year cooperative Global Positioning System (GPS) experiment involving 6 universities and institutions in New Zealand and the United States. The investigation covers two scales, the first on the scale of plates (approximately 1000 km) and the second is on the scale of the plate boundary zone (approximately 50 km). In the first portion of the experiment, phase A, the objective is to make direct measurements of tectonic plate motion between the Australian and Pacific plates using GPS in order to determine the Euler vector of this plate pair. The phase A portion of this experiment was initiated in December 1992 with the first-epoch baseline measurements on the large scale network. The network will be resurveyed two years later to obtain velocities. The stations which were observed for phase A are shown and listed. Additional regional stations which will be used for this study are listed and are part of either CIGNET or other global tracking networks. The phase A portion of the experiment is primarily the responsibility of the UNAVCO investigators. Therefore, this report concentrates on phase A. The first year of NASA funding for phase A included only support for the field work. Processing and analysis will take place with the second year of funding. The second part of the experiemnt measured relative motion between the Australian and Pacific plates across the pate boundary zone between Hokitika and Christchurch on the South Island of New Zealand. The extent and rate of deformation will be determined by comparisons with historical, conventional surveys and by repeated GPS measurements to be made in two years. This activity was the emphasis of the LDGO portion of the study. An ancillary experiment, phase C, concentrated on plate boundary deformation in the vicinity of Wellington and was done as part of training during the early portion of the field campaign. Details of the objectives of the field investigations are given in the appendix. An overview of the 1992 GPS field program is also given in the appendix. Author

N93-16969# Lawrence Livermore National Lab., CA.

AEROSOL TRANSPORT AND GLOBAL MODELS

J. E. Penner Sep. 1992 5 p Presented at the NASA Workshop on Global Aerosols and Biogeochemistry, Orlando, FL, 1-3 Sep. 1992

(Contract W-7405-eng-48)

(DE93-001618; UCRL-JC-111820; CONF-9209246-1) Avail: CASI HC A01/MF A01

Recently, attention has been focused mainly on the effects of anthropogenic aerosols on climate. Anthropogenic aerosols may cool the climate by direct reflection of solar radiation and by their effect on clouds. This report discusses the effects of several components on global models, and discusses the transport of these aerosols. DOE

N93-17092*# California Univ., Santa Barbara. Institute for Crustal Studies.

AN INVESTIGATION OF EXTENSIONAL TECTONICS OF SOUTHERN CALIFORNIA

Steven M. Richard and John C. Crowell 1 Dec. 1992 44 p

(Grant NAGw-1246)

(NASA-CR-191359; NAS 1.26:191359) Avail: CASI HC A03/MF A01

Geologic mapping and interpretation of Landsat TM imagery has filled in a significant gap in the geologic database for southwestern Arizona and southeastern California. The new data acquired, along with interpretation of existing data, forms the basis for a proposed reconstruction of late Tertiary faults in these regions. This reconstruction integrates available geological and geophysical data to define the eastern limit of deformation related to the San Andreas fault, and has significant implications for other recently proposed reconstructions of Tertiary deformation in the region. This progress in interpreting deformation during the last 10 Ma in the region forms a foundation for developing and testing models of older deformation in this region, including the initiation of San Andreas fault system, and the interaction of Early Miocene extension in the Basin and Range with the evolving San Andreas system. For individual title, see N93-17093.

N93-17093*# California Univ., Santa Barbara. Institute for Crustal Studies.

PALINSPASTIC RECONSTRUCTION OF SOUTHEASTERN CALIFORNIA AND SOUTHWESTERN ARIZONA FOR THE MIDDLE MIOCENE

Stephen M. Richard *In its* An Investigation of Extensional Tectonics of Southern California 1 Dec. 1992 38 p (For primary document see N93-17092 05-46)

Avail: CASI HC A03/MF A01

A paleogeographic reconstruction of southeastern California and southwestern Arizona at 10 Ma was made based on available geologic and geophysical data. Clockwise rotation of 39 deg was reconstructed in the eastern Transverse Ranges, consistent with paleomagnetic data from late Miocene volcanic rocks, and with slip estimates for left-lateral faults within the eastern Transverse Ranges and NW-trending right lateral faults in the Mojave Desert. This domain of rotated rocks is bounded by the Pinto Mountain fault on the north. In the absence of evidence for rotation of the San Bernardino Mountains or for significant right slip faults within the San Bernardino Mountains, the model requires that the late Miocene Pinto Mountain fault become a thrust fault gaining displacement to the west. The Squaw Peak thrust system of Meisling and Weldon may be a western continuation of this fault system. The Sheep Hole fault bounds the rotating domain on the east. East of this fault an array of NW-trending right slip faults and south-trending extensional transfer zones has produced a basin and range physiography while accumulating up to 14 km of right slip. This maximum is significantly less than the 37.5 km of right slip required in this region by a recent reconstruction of the central Mojave Desert. Geologic relations along the southern boundary of the rotating domain are poorly known, but this boundary is interpreted to involve a series of curved strike slip faults and non-coaxial extension, bounded on

the southeast by the Mammoth Wash and related faults in the eastern Chocolate Mountains. Available constraints on timing suggest that Quaternary movement on the Pinto Mountain and nearby faults is unrelated to the rotation of the eastern Transverse Ranges, and was preceded by a hiatus during part of Pliocene time which followed the deformation producing the rotation. The reconstructed Clemens Well fault in the Orocopia Mountains, proposed as a major early Miocene strand of the San Andreas fault, projects eastward towards Arizona, where early Miocene rocks and structures are continuous across its trace. The model predicts a 14 deg clockwise rotation and 55 km extension along the present trace of the San Andreas fault during late Miocene and early Pliocene time. Palinspastic reconstructions of the San Andreas system based on this proposed reconstruction may be significantly modified from current models. Author

N93-17193# California Univ., Berkeley. Lawrence Berkeley Lab.
PRELIMINARY RESERVOIR ENGINEERING STUDIES OF THE MIRAVALLES GEOTHERMAL FIELD, COSTA RICA
C. Haukwa, G. S. Bodvarsson, M. J. Lippmann, and A. Mainieri (Costa Rican Inst. de Electricidan, San Jose.) Jan. 1992 12 p Presented at the 17th Workshop on Geothermal Reservoir Engineering, Stanford, CA, 29-31 Jan. 1992
(Contract DE-AC03-76SF-00098)
(DE93-000631; LBL-32140; CONF-920119-5) Avail: CASI HC A03/MF A01

The Earth Sciences Division of Lawrence Berkeley Laboratory in cooperation with the Instituto Costarricense de Electricidad is conducting a reservoir engineering study of the Miravalles geothermal field, Costa Rica. Using data from eight exploration wells, a two-dimensional areal, natural-state model of Miravalles has been developed. The model was calibrated by fitting the observed temperature and pressure distributions and requires a geothermal upflow zone in the northern part of the field, associated with the Miravalles volcano and an outflow towards the south. The total hot (about 260 C) water recharge is 130 kg/s, corresponding to a thermal input of about 150 MWt. On the basis of the natural-state model, a two-dimensional exploitation model was developed. The field has a production area of about 10 km(exp 2), with temperatures exceeding 220 C. The model indicated that power generation of 55 MWe can be maintained for 30 years, with or without injection of the separated geothermal brine. Generation of 110 MWe could be problematic. Until more information becomes available on the areal extent of the field and the properties of the reservoir rocks, especially their relative permeability characteristics, it is difficult to ascertain if 110 MWe can be sustained during a 30-year period. DOE

N93-17460# Oak Ridge National Lab., TN.
GEOPHYSICAL INVESTIGATION AND CHARACTERIZATION WITH USRADS
C. R. Flynn, M. S. Blair (Chemrad Tennessee Corp., Oak Ridge.), and J. E. Nyquist 1992 19 p Presented at the Symposium on Application of Geophysics to Engineering and Environmental Problems, Oakbrook, IL, 26-29 Apr. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001363; CONF-9204205-2) Avail: CASI HC A03/MF A01

This paper describes two recent case histories in which commercially available geophysical instruments were used with an innovative tracking and mapping system called USRADS (UltraSonic Ranging And Data System) that automates data location and collection. USRADS uses ultrasonics to provide real-time surveyor positioning and radio links to transmit the surveyor data to an on-site computer for storage and real-time display. USRADS uses a standard 386 computer for data collection and includes real-time color display of the findings. It also includes numerous analysis and display formats for on-site, as well as utilities to facilitate post-process analysis of the findings. The objective of one project was to locate several suspect waste disposal trenches and to map their boundaries. The second was to locate and map the presence of subsurface unexploded ordinance (UXO) at a suspect artillery impact area. A Geonics EM31 terrain conductivity meter interfaced to USRADS was used to map the suspect trenches. A Schonstedt GA-52C magnetometer interfaced to USRADS was used to map the subsurface UXO. Correlation of findings to known site features and additional knowledge about the sites indicates that these efforts did locate and map the geophysical features including the suspect waste trenches and the subsurface UXO. Images of the findings generated on-site and during post-processing are included. DOE

N93-17480# Pacific Northwest Lab., Richland, WA.
EFFECTS OF MESOSCALE SURFACE INHOMOGENEITIES ON ATMOSPHERIC BOUNDARY LAYER TRANSFER
W. J. Shaw, J. C. Doran, and J. M. Hubbe Sep. 1992 17 p Presented at the 10th Symposium on Turbulence and Diffusion, Portland, OR, 29 Sep. - 2 Oct. 1992
(Contracts DE-AC06-76RL-01830; W-31-109-eng-38; W-7405-eng-36)
(DE93-001515; PNL-SA-21231; CONF-9209158-5) Avail: CASI HC A03/MF A01

Defining the nature of turbulent transfer over horizontally inhomogeneous surfaces remains one of the challenges in meteorology. Because the transfer of energy and momentum through the atmospheric boundary layer forms part of the lower boundary condition for global climate models (GCM's), the problem is important. Over the last two decades, advances in sensor and computer technology have made good point measurements of turbulent fluxes fairly routine. A fundamental question with respect to climate models, however, is how such point measurements are related to average fluxes over the area of a GCM grid box. Data from the field program is used to depict the evolution of the boundary layer over adjacent, sharply contrasting surface types on two separate occasions. We will then use simple scaling based on the observations to argue that sub-gridscale motions would often be likely to significantly alter the estimates and resulting parameterizations of GCM-scale surface fluxes in the region. DOE

N93-17573# Lawrence Livermore National Lab., CA.
AN INVESTIGATION OF THE DEPENDENCE OF ATMOSPHERIC RADIATIVE TRANSFER ON AEROSOL SIZE DISTRIBUTION
C. R. Molenkamp Oct. 1992 43 p
(Contract W-7405-eng-48)
(DE93-003333; UCRL-ID-112135) Avail: CASI HC A03/MF A01

The effect of aerosol particle size distribution on the transfer of solar and infrared radiation in the Atmosphere is investigated by calculating radiances using LOWTRAN 7. We show that measurable changes occur in downward direct and scattered solar radiance for a background rural aerosol as the mode radius and standard deviation are changed. Aerosols with particles primarily larger than 0.5 micron have fairly uniform effects at visible wavelengths, while aerosols with particles mainly smaller than 0.1 micron scatter more sunlight as the wavelength becomes shorter. The largest sensitivity to changes in particle size occur in the downward scattered solar, indicating that this parameter would be most likely to provide an indication of aerosol size distribution and optical properties. Upward scattered sunlight is increased only slightly by background amounts of boundary layer aerosol. Increased absorption by aerosol particles had only a small effect on the downward direct solar radiance, but produced a large relative change in downward scattered solar radiance. The presence of background amounts of boundary layer aerosol had no measurable effect on infrared fluxes. DOE

N93-17586# Technische Univ., Delft (Netherlands). Seismics and Acoustics Lab.
SURFACE-RELATED MULTIPLE ELIMINATION, AN INVERSION APPROACH Ph.D. Thesis
Dirk Jacob Verschuur 1991 235 p Sponsored by Netherlands Technology Foundation, and DELPHI Consortium
(ISBN-90-9004520-1; ETN-92-92530) Copyright Avail: CASI HC A11/MF A03

The investigation of the surface related multiple elimination method, which is applied as an inversion process to seismic data, is reported. The theory of multiple elimination was anticipated by reviewing a suitable version of the seismic forward model. The theory of surface related multiple elimination is described by applying the inverse of the multiple generating operator to the data. The marine situation and then the multicomponent land data is considered. The matrix notation is extensively used. The surface related multiple elimination process is illustrated in simulated data, generated by a second order finite difference technique. Problems that may be encountered when working on field data are then addressed. The implementation aspects of the surface related multiple elimination method are discussed. A strategy of how to apply adaptative multiple elimination on field data is given. The full surface related multiple elimination procedure

is demonstrated in two marine field data examples. An efficient version of the surface related multiple elimination process is discussed, which acts on individual CMP gathers. Conclusions related to the theoretical and practical aspects of surface related multiple elimination are given. It is argued that surface related multiple elimination may start a new direction in seismic processing that involves inversion of multiple energy. It is concluded that the surface related multiple elimination process (including preprocessing) solves the seismic signal to noise problem to a very large extent. ESA

N93-17634# Observatorio del Ebro, Roquetas (Spain).
MODELING THE GEOMAGNETIC FIELD OVER SPAIN: ANOMALOUS FIELD, SECULAR VARIATION, AND REFERENCE FIELD [MODELIZACION REGIONAL DEL CAMPO GEOMAGNETICO SOBRE ESPANA: CAMPO ANOMALO, VARIACION SECULAR Y CAMPO DE REFERENCIA]
J. M. Torta 1992 149 p In SPANISH
(Memo-15; ISBN-84-88253-00-1; ETN-92-92617) Avail: CASI HC A07/MF A02

The study and modeling of the core and crystal contributions of the geomagnetic field over Spain and neighboring areas are presented with particular attention to the correct separation of each individual contribution. Spherical Cap Harmonic Analysis (SCHA) was the chosen technique. This ensures an analytical solution for a potential within a region defined by a spherical cap. This solution is presented in terms of a uniformly convergent infinite expansion for both the potential and its derivatives, so that ringing at the boundary is avoided. One of the aims for producing the secular variations model was to have an appropriate tool to update Magsat and old ground data with which to get an actual Spanish reference field. The poor distribution of ground data required the analysis to be confined to an 8 deg cap. Hence all data values within this cap were updated to 1990 by means of the integrated secular variation model. Before applying SCHA the international geomagnetic reference field of 1985, evaluated at 1990, was removed and only residuals were analyzed. Charts of all the elements of this 1990 reference field are shown, with the secular variation maps for that epoch from the secular variation model. ESA

N93-17653# Pacific Northwest Lab., Richland, WA.
INTERNAL GRAVITY WAVES IN THE EQUATORIAL PACIFIC
E. D. Skyllingstad and D. W. Denbo (Battelle Pacific Northwest Labs., Sequim, WA.) Sep. 1992 6 p Presented at the 10th Symposium on Turbulence and Diffusion, Portland, OR, 29 Sep. - 2 Oct. 1992
(Contract DE-AC06-76RL-01830)
(DE93-001517; PNL-SA-21163; CONF-9209158-6) Avail: CASI HC A02/MF A01

Mixing in the ocean surface layer is an important process in the transport of heat, momentum, and CO2 into the deep ocean. For example, the flux of heat into the cold, upwelling water in equatorial regions provides one of the major heat sources driving the ocean circulation. Direct measurements of the ocean mixed layer have provided good estimates of the bulk layer properties. However, estimates of the small-scale effects of intenial waves and related turbulence have remained ambiguous because of the difficulty in observing these processes. Until more detailed measurements become available, numerical models can provide a convenient and cost-effective way to analyze the details of the surface mixed layer. Modeling the surface layer of the equatorial Pacific Ocean is challenging because of the strong vertical current shear and density stratification common to the region. The primary zonal current is the eastward flowing Equatorial Undercurrent (EUC) centered at roughly 120 m depth, with a speed of about 1.5 ms(exp -1) as shown in Figure 1. The EUC is forced by a zonal pressure gradient resulting from the westward directed surface wind stress. Above the EUC, the wind stress directly forces thee South Equatorial Current (SEC), which flows westward with a speed of about 0.5 ms(exp -1). The shear zone generated by these currents is marginally stable and exhibits a diurnal cycle of turbulence dependent on convection forced by surface cooling. In addition, surface convection forces internal gravity waves, which can transport momentum away from the surface current to deeper waters. In this report, we discuss recent modeling results for the equatorial Pacific showing the generation of convection, turbulence, and internal waves. DOE

N93-17312*# Fisk Univ., Nashville, TN. Dept. of Physics.
THE IONOSPHERE AS A GAMMA RAY BURST DETECTOR
Charles H. McGruder, III *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N93-15661# Westinghouse Savannah River Co., Aiken, SC.
A COMPARISON OF THE WIND SYSTEM ATMOSPHERIC MODELS AND RASCAL
J. D. Fast 1991 46 p
(Contract DE-AC09-89SR-18035)
(DE92-040207; WSRC-RP-91-894) Avail: CASI HC A03/MF A01

A detailed comparison of the characteristics of the WIND System atmospheric models and the NRC's RASCAL code was made. The modeling systems differ substantially in the way input is entered and the way output is displayed. Nevertheless, using the same source term and meteorological input parameters, the WIND System atmospheric models and RASCAL produce similar results in most situations. The WIND System atmospheric model predictions and those made by RASCAL are within a factor of two at least 70 percent of the time and are within a factor of four 89 percent of the time. Significant differences in the dose between the models may occur during conditions of low wind speeds, strong atmospheric stability, and/or wet deposition as well as for many atmospheric cases involving cloud shine. Even though the numerical results are similar in most cases, there are many site-specific and operational characteristics that have been incorporated into the WIND System atmospheric models to provide SRS emergency response personnel with a more effective emergency response tool than is currently available from using RASCAL. DOE

N93-15701# Phillips Lab., Hanscom AFB, MA.
CLOUD DATA SET FOR NEURAL NETWORK CLASSIFICATION STUDIES Final Report
Rupert S. Hawkins, K. F. Heideman, and Ira G. Smotroff (Mitre Corp., Bedford, MA.) 23 Jan. 1992 24 p
(AD-A256666; AD-E201196; PL-TR-92-2027; ERP-1097) Avail: CASI HC A03/MF A01

A large set of GOES imagery has been analyzed to generate a cloud data set for neural network classification studies. The classification scheme uses 13 classes of clouds. The cloud data base is large enough to allow cross-validation tests of automated cloud classification techniques. The methods used to acquire the data on cloud type and a brief overview of the planned automated classification experiments are presented. The appendix contains an inventory of the cloud data set. GRA

N93-15871# Naval Oceanographic and Atmospheric Research Lab., Monterey, CA.
EXPERCAT CASE STUDIES Final Report
Richard L. Bankert May 1992 43 p
(AD-A256177; NOARL-TN-255) Avail: CASI HC A03/MF A01

ExperCAT, an expert system that provides analysis and short-term forecasts (less than 6 hours) of clear air turbulence (CAT), is evaluated through an intercomparison with U.S. Air Force (USAF) turbulence charts. Seven case studies are presented. Using a meteorologist who was not involved in the development of ExperCAT as the end user for the test, five of the cases produced results that were in agreement with the USAF charts. A variety of possible reasons can explain the lack of agreement in the other two cases. These possibilities include the general type of coverage on the USAF charts as compared to the more detailed analysis of ExperCAT, an insufficient number of high quality satellite images, or an inadequate rule base in ExperCAT. Suggestions are made for system enhancements that would help the uninitiated user and expand the explanation facility of ExperCAT. GRA

N93-15947# Argonne National Lab., IL. Environmental Research Div.
SOME SIMPLE IMPROVEMENTS TO AN EMERGENCY RESPONSE MODEL FOR USE IN COMPLEX COASTAL TERRAIN

N. L. Miller Jun. 1992 31 p
(Contract W-31-109-eng-38)
(DE92-040648; ANL/ER/TM-2) Avail: CASI HC A03/MF A01

The MACHWIND model (Meyers 1989) is one of a group of models used to compute regional wind fields from tower wind data and/or vertical wind profiles. The wind fields are in turn used to calculate atmospheric diffusion, to guide emergency responses. MACHWIND has performed acceptably in uniform terrain under steady, well mixed conditions. However, extension of the model to more complex situations is problematic. In coastal, hilly terrain like that near Vandenberg Air Force Base (VAFB) in southern California, calculations of the wind field can be enhanced significantly by several modifications to the original code. This report highlights the structure of MACHWIND and details the enhancements that were implemented.

DOE

N93-15960# Phillips Lab., Hanscom AFB, MA.
REFINEMENT AND TESTING OF THE RADIATIVE TRANSFER PARAMETERIZATION IN THE PL GLOBAL SPECTRAL MODEL Interim Report
John L. Schattel 18 Jun. 1992 34 p
(AF Proj. 6670)
(AD-A256840; AD-E201232; PL-TR-92-2169; ERP-1103) Avail: CASI HC A03/MF A01

As part of a larger initiative to develop a research-grade advanced physics global spectral numerical weather prediction model, an atmospheric radiative transfer parameterization scheme that interacts with model clouds was developed. It was incorporated into the Phillips Laboratory (PL) global spectral model along with state-of-the-art schemes to account for boundary layer exchange process, cumulus convections, and gravity wave drag. The radiation scheme employs a broadband approach to account for longwave and shortwave fluxes in clear and cloudy atmospheres. For cloud regions, up to three cloud decks can be handled, corresponding to low, middle, and high clouds. Several procedures to transform the model's distribution of relative humidity at each gridpoint to the three deck cloud solution were evaluated. A variation of the so-called Slingo scheme employed in the global model of the European Centre of Medium-range Weather Forecasting was selected. The radiation flux calculations proceed with one of seven possible cloud layer scenarios and use maximum overlap assumptions. Global model experiments with the cloud-radiation scheme confirmed the successful simulation of observed outgoing longwave radiation (from satellite observations) both in its magnitude and in the proper placement geographically of extrema. Improvements in the global model heating rate profiles resulted, in turn, in improved temperature forecasts throughout the model troposphere/stratosphere. GRA

N93-16096# Analytic Sciences Corp., Reading, MA.
CLOUD SCENE SIMULATION MODELING Report No. 1
M. E. Cianciolo, J. S. Hersh, and M. P. Ramos-Johnson 20 Nov. 1991 82 p
(Contract F19628-90-C-0022)
(AD-A256689; PL-TR-91-2295; AD-E201214) Avail: CASI HC A05/MF A01

The development is documented of the prototype and interim versions of the Cloud Scene Simulation Model in support of the Smart Weapons Operability Enhancement Program under the Balanced Technology Initiative. The model simulates multi-dimensional cloud water density fields using stochastic field generation techniques (the sawtooth wave and successive random additions fractal algorithms) and knowledge of atmospheric structure for input to radiative transfer models and scene generation systems. Two auxiliary post-processor programs are also described. The first generates a two-dimensional shadow map from a cloud field as a function of solar position. The second converts a gridded field to a colored polygonal isosurface for use in scene visualization. Included are the results of a comparison of model produced and observed liquid water density statistics along paths through clouds of various types using data provided by the FAA. Plans for further model development (including the addition of a cumuliform model) are described. GRA

N93-16117# Naval Postgraduate School, Monterey, CA.
MATHEMATICAL MODEL AND COMPUTER ALGORITHM FOR TRACKING COASTAL STORM CELLS FOR SHORT TERM TACTICAL FORECASTS M.S. Thesis
Carl A. Carpenter Sep. 1992 109 p
(AD-A257110) Avail: CASI HC A06/MF A02

An algorithm has been developed for real-time forecasting of precipitation storm cell movement over water. The key to the algorithm is the Kalman filter tracking model which is continually updating the mean value and error covariance matrix of a cell's centroid position from past measurements. The algorithm was developed and applied to precipitation cells to evaluate the advantages of utilizing an optimal recursive processing program to assist in making short term tactical forecasts. This tracking algorithm was designed for use in a stand alone desktop computer. All of the real-time tracking data was detected by a land-based radar system. The thesis results suggest that for short term forecasting the Kalman filter can produce some improvements over other tracking models, but further refinement in identifying the storm cell center and mathematically identifying the area of extent of each individual cell is needed. Other possible improvements to the tracking algorithm might include a methodology to identify what meteorological parameters need to be included in the motion model.

GRA

N93-16153# Naval Postgraduate School, Monterey, CA.
MULTISPECTRAL ANALYSIS OF MARITIME CLOUDS AT NIGHT IN THE PRESENCE OF ATMOSPHERIC WATER VAPOR M.S. Thesis
Christopher K. Brooks Jun. 1992 82 p
(AD-A256699) Avail: CASI HC A05/MF A01

Multispectral analysis methods are exercised using AVHRR channels 3, 4, and 5 to improve upon single wavelength thermal imagery at night. An algorithm was developed yielding cloud location and water vapor distribution from channel 3-4 and 4-5 differences, respectively. Water vapor effects on pixel registration for cloud were examined using two candidate subscenes, one cloudy and dry, the other, cloudy and moist. A positive water vapor/cloud-free correlation was found using statistical techniques on the candidate subscene scatter plots. TOVS water vapor channels verified the analyzed water vapor pattern in the 4-5 difference image. V-shaped cloud/clear thresholds were applied to various subscene scatter plots to account for the positive correlation of water vapor-to-cloud registration. Results showed that in regions of higher water vapor concentrations, pixels nearest cloud boundaries were likeliest to be misclassified as clear. Images containing significant water vapor gradients and cloud variations required threshold refinement for best results. GRA

N93-16167# Phillips Lab., Hanscom AFB, MA.
PROCEEDINGS OF THE FIRST NMC/NESDIS/DOD CONFERENCE ON DMSP RETRIEVAL PRODUCTS Interim Report
Ronald G. Isaacs, Eugenia Kalnay, George Ohring, and Robert A. McClatchey 3 Aug. 1992 272 p Proceedings held in Washington, DC, 14-15 Apr. 1992 LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(AD-A256707; AD-E201219; PL-TR-92-2191; ERP-1104) Avail: CASI HC A12/MF A03

A collection of papers on products from the Defense Meteorological Satellite Program (DMSP) sensors, particularly the SSM/T and SSM/I products are presented. Partial contents include: SM/I: Status Report; Calibration/Validation of the DMSP Microwave Water Vapor Sounder (SSM/T-2); Performance of DMSP Special Sensor Microwave Humidity Profiler (SSM/T-2) Preliminary Results; DMSP Block 6: A Data Driven Approach; NOAA/NESDIS: Operational SSM/T Products and Distribution; NOAA/NESDIS SSM/T Algorithms and Evaluation; Defense Meteorological Satellite Program Microwave Radiometer Processing at Air Force Global Weather Central; DMSP Special Sensor Microwave/Imager Processing at the Fleet Numerical Oceanography Center: Operational Status, Application and Plans; An Overview of the Experimental SSM/I Orbit-by-Orbit Products System (SSMIPROD) at NOAA/NESDIS; SSM/I Mapped Experimental Environmental Image Products; SSM/I Total Precipitable Water Vapor Algorithms: A Reprise and Update; The Use of the DMSP SSM/I for the Generation of Precipitation Products at NOAA/NESDIS: Part 1: A Status Report; The Use of the DMSP SSM/I for the Generation of Precipitation Products at NOAA/NESDIS: Part 2: Scientific Results; Production and Evaluation of Experimental SSM/I Ice and Wind Products at NOAA/NESDIS; Real Time Quality Control of SSM/I Wind Speed Data; Status of NESDIS Distribution of SSM/I Products; Processing and Distributing SSM/I Data via the Wet Net Project. GRA

N93-16169# Washington Univ., Saint Louis, MO. Center for Air Pollution Impact and Trend Analysi s.

AEROSOL AND LIGHT EXTINCTION DATABASES FOR NORTH AMERICA AND EUROPE Final Report, 18 Dec. 1986 - 14 Mar. 1991

Rudolf B. Husar and Bret A. Schichtel 10 Jun. 1992 64 p

(Contract F19628-87-K-0003)

(AD-A256710; PL-TR-92-2156; AD-E201217) Avail: CASI HC A04/MF A01

This study describes the databases assembled for the project Climate and Properties of Atmospheric Aerosols. This database description (metadata) is provided to aid the data usage by other researchers. Applications of the database include atmospheric transmission models (e.g. LOWTRAN), global change studies, air pollution studies, and general contribution to atmospheric sciences. The four major aerosol databases include: (1) Extinction coefficients for Europe (1977-1986) for 1,200 synoptic stations; (2) Extinction coefficient for North America (1948-1983) for 350 stations; (3) Aerosol mass and chemical composition data for 37 U.S. background stations; (4) Aerosol mass and chemical composition for the northeastern U.S. These primary databases are augmented by an array of derived (filtered, aggregated, reconciled) databases. The data are provided both in portable ASCII form, as well as in efficient binary form. The binary data are suitable for browsing by the Voyager data browser which is supplied with the data set. GRA

N93-16170# Phillips Lab., Hanscom AFB, MA.

RADAR OBSERVATIONS OF THE EFFECTS OF CHANGING ELECTRIC FIELDS ON THE ORIENTATIONS OF HYDROMETEORS Interim Report

James I. Metcalf 14 May 1992 36 p

(AD-A256712; AD-E201160; PL-TR-92-2122; ERP-1100) Avail: CASI HC A03/MF A01

The changing orientations of hydrometeors due to rapidly changing electric fields in clouds have been observed for the first time at a radar wavelength of 11 cm (S-band) with the polarimetric Doppler radar operated in Sudbury, MA by the Geophysics Directorate of Phillips Laboratory. During 1991 the radar was operated in a half-matrix mode, transmitting a signal of right circular polarization and receiving signals of right and left circular polarization. Observations of electrified storms on nine days during the spring and summer of 1991 revealed several occurrences of lightning that coincided with significant changes of the circular depolarization ratio (CDR), the cross-correlation, or the phase of the cross-covariance of the two received signals. Changes up to 2 dB in CDR, 50 pct. in cross-correlation, and 40 deg in phase were observed. However, many occurrences of lightning observed by radar were not accompanied by detectable changes of hydrometeor orientations, and there were no observations of the cyclical changes of the polarimetric quantities that have been observed elsewhere with radars of shorter wavelength. Examples of observations are presented and implications for future measurements with this radar are discussed. GRA

N93-16172# Phillips Lab., Hanscom AFB, MA.

CRRESRAD DOCUMENTATION Interim Report

Kevin J. Kerns and M. S. Gussenhoven 6 Aug. 1992 30 p

(AD-A256715; AD-E201226; PL-TR-92-2201; ERP-1105) Avail: CASI HC A03/MF A01

CRRESRAD is a utility that predicts satellite dose accumulation behind different thicknesses of aluminum hemispheres for specified orbits. Dose accumulation is predicted by using empirical dose rate models created using data measured on the Combined Release and Radiation Effects Satellite (CRRES) which flew in a geosynchronous transfer orbit for 14 months during solar maximum. The dose models give dose rates for quiet, average, and active conditions during solar maximum which can be used to give best and worst case dose rates. CRRESRAD is best applied to orbits with inclinations less than 30 deg. It is useful for higher inclination orbits if the user is primarily interested in dose caused by protons or dose accumulated behind thick shielding (greater than 200 mils aluminum). GRA

N93-16409# Naval Postgraduate School, Monterey, CA.

SCIENTIFIC DEVELOPMENT OF A MASSIVELY PARALLEL OCEAN CLIMATE MODEL Progress Report, 1991-1992

A. J. Semtner, Jr. and R. M. Chervin (National Center for Atmospheric Research, Boulder, CO.) 1992 4 p

(DE92-040508; DOE/ER-61223/1) Avail: CASI HC A01/MF A01

A thorough examination was made of existing results from the global ocean model with high resolution. Additional experiments were chosen to help investigate the sensitivity of global ocean circulation and its associated transports of heat and salt to proposed changes in high-latitude buoyancy forcing and wind forcing. Author

N93-16457 Department of the Navy, Washington, DC.

METHOD AND APPARATUS FOR ACOUSTICALLY MEASURING RAINFALL Patent

Albert B. Caron, inventor (to Navy) 30 Jun. 1992 7 p Filed 8 Jul. 1992

(AD-D015450; US-Patent-5,125,268; US-Patent-Appl-SN-728905; US-Patent-Class-73-171) Avail: US Patent and Trademark Office

A method and apparatus are provided for acoustically measuring precipitation rates and total amounts of rainfall. The rainfall is collected in a reservoir and drained through a gravity feed tube system. The gravity feed tube system receives a steady flow, of rainfall draining from the reservoir and converts the steady flow into drops by means of surface tension within the tube system. The formed drops exit the tube system and impact a surface that is acoustically responsive to the impact. The acoustically responsive surface is monitored to count the number of drops impacting same, wherein the number of drops counted is indicative of the precipitation rate and total amount of rainfall. GRA

N93-16477# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Abteilung Meteorologische Fernerkundung.

IDENTIFICATION OF ICING WATER CLOUDS BY NOAA AVHRR SATELLITE DATA [IDENTIFIKATION VON VEREISENDEN WASSERWOLKEN MITTELS NOAA-AVHRR-SATELLITENDATEN]

Klaus-Peter Schickel, Hans-Eberhard Hoffmann, and Karl-Theodor Kriebel Apr. 1992 47 p In GERMAN

(DLR-FB-92-11; ETN-93-92403) Avail: CASI HC A03/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

It is shown that water clouds and their top temperature can be identified from NOAA Advanced Very High Resolution Radiometer (AVHRR) data. It may lead to an overestimation of the risk of icing, because water clouds with little Liquid Water Content (LWC) are not distinguished from those with a sufficiently high LWC. Icing can be partly underestimated on account of undetected water clouds underneath ice clouds. The technique to determine water cloud from AVHRR data is presented. The results are validated in 21 cases by airborne measurements. The possibility of improving the icing forecast by using the LWC and its derivation for AVHRR data is discussed. ESA

N93-16506 State Univ. of New York, Albany.

A THREE-DIMENSIONAL MODEL OF CLOUD DYNAMICS, MICROPHYSICS, AND CHEMISTRY Ph.D. Thesis

Chien Wang 1992 228 p

Avail: Univ. Microfilms Order No. DA9230029

A three-dimensional, comprehensive cloud modeling system with detailed descriptions of dynamics, microphysics, and chemistry has been developed. This system can be used to study not only the evolution of dynamical and microphysical processes, but also those of chemical processes and the interactions or relationships among them. The primary objective of this model is the simulation of deep convective events and severe storms. The physical components of this model starts with a pseudo-elastic form of the continuity equation. The overall model is a self-consistent, time-dependent system which is easier to solve. Seven different water categories in three phases are considered in this model. Both the mass mixing ratio and concentration of each liquid or solid phase category are predicted so that a semi-spectra microphysical parameterization scheme can be formulated. More than 40 microphysical processes have been parameterized based on the spectrum-integration and the behavior of the individual particles in the microphysical interactions. Concentrations of seven chemical groups in air and in 6 liquid- or solid-phase water carriers are predicted by our chemical model. Their evolution in this model came from not only the dynamical and subgrid-scale transports, but also the chemical reactions and microphysics-related conversions. A strong convective storm, the 1 August 1981 case of CCOPE project, has been modeled by using our

three-dimensional modeling system. The modeled precipitation feature and three-dimensional radar reflectivity factors are close to the observed data. The modeled main chemical parameters are also reasonable. The evolution of dynamical and thermodynamical structure of the storm, the formation and the evolution of precipitation, the redistribution of chemical species, the evolution of cloud and precipitation chemical features, and the relationships among dynamical, microphysical, and chemical processes have been studied through the case study. Some observed phenomena have also been reasonably explained by the modeling results. Dissert. Abstr.

N93-16507 Colorado State Univ., Fort Collins.
MODELING AND OBSERVATIONAL STUDY OF THE DAYTIME EVOLUTION EAST OF THE CREST OF THE COLORADO ROCKIES Ph.D. Thesis
Paul George Wolyn 1992 263 p
Univ. Microfilms Order No. DA9231842

The west-east nature of the daytime evolution east of the Front Range of the Colorado Rockies in the vicinity of Fort Collins, Colorado is examined for conditions of clear skies, little change to the synoptic-scale wind and thermal fields, and light ambient winds with a westerly component (around 5 ms(exp -1)). The observations mainly consist of air-sondes launched at every 2-3 hours at sites on the eastern plains and on the east slope of the mountain barrier. A variety of two-dimensional simulations using the CSU RAMS are run with varying initial conditions that change the surface heating, ambient winds, ambient thermal structure, and barrier height. A full nighttime phase is simulated before the daytime phase. From the observations and simulations a conceptual model of the daytime is developed. The sunrise state includes a strong jet down the east side of the barrier and a deep layer of stability to the east of the barrier. Phase 1 of the evolution lasts until 3-4 hours after sunrise and results from the weakening nocturnal flow interacting with the early daytime heating. Phase 2 has a solenoid which is not symmetric horizontally and which does not develop uniformly with time. Phase 3 is characterized by a solenoid which migrates eastward. The variety of simulations show how the daytime evolution changes for the various initial conditions. Generally, the solenoid in phases 2 and 3 is weaker and shallower for moister soil (less surface sensible heat flux) on the plains east of the barrier, moister soil west of barrier crest, days closer to the winter solstice, stronger ambient winds, and a lower convective boundary layer (CBL) the previous day. The solenoid is generally deeper and stronger for less ambient stability and days closer to the summer solstice. The usefulness of vertical integrals of heating and mass flux in the analysis of simulations and observations is explored in this study. These vertical integrals quantify the movement of energy and mass at different heights by the circulations, and they are very useful for comparing the strength and depth of the circulations among simulations and between the simulations and observations. Dissert. Abstr.

N93-16584# Naval Postgraduate School, Monterey, CA.
SCIENTIFIC DEVELOPMENT OF A MASSIVELY PARALLEL OCEAN CLIMATE MODEL Progress Report, 1991-1992
A. J. Semtner, Jr. and R. M. Chervin Mar. 1992 5 p Prepared in cooperation with National Center for Atmospheric Research, Boulder, CO
(Contract DE-AI05-91ER-61224)
(DE92-040517; DOE/ER-61224/1) Avail: CASI HC A01/MF A01

Experiments to investigate the sensitivity of global ocean circulation and its associated transports of heat and salt to proposed changes in high-latitude buoyancy forcing and wind forcing. An experiment was designed to improve the representation of water-mass production in areas of known deep water formation. At the same time, almost all of the deep and abyssal regions of the world ocean were freed from earlier restoring to observed values of temperature and salinity. This convective forcing experiment has been run on the NCAR Y-MP/864 for three years of a planned five-year sensitivity study. DOE

N93-16601# Oak Ridge National Lab., TN.
CLOUD AMOUNT AND SUNSHINE DURATION IN THE PEOPLE'S REPUBLIC OF CHINA, 1954-1988
D. Kaiser 1992 10 p Presented at the 73d American Meteorological Society Annual Meeting, Anaheim, CA, 17-22 Jan. 1993
(Contract DE-AC05-84OR-21400)
(DE92-041023; CONF-930133-1) Avail: CASI HC A02/MF A01

A part of the world with extensive records of cloudiness is the People's Republic of China (PRC). These data, along with records of other meteorological observations, have recently been made available through a joint research agreement established between the US Department of Energy (DOE) and the PRC Chinese Academy of Sciences (CAS) for the purpose of studying possible global warming due to an enhanced greenhouse effect. This paper examines the variation of PRC cloudiness, along with that of sunshine duration (a useful measure of cloudiness), over the 35-year period: 1954 to 1988. DOE

N93-16623*# General Electric Co., Princeton, NJ. Astro Space Div.
DEFINITION AND PRELIMINARY DESIGN OF THE LAWS (LASER ATMOSPHERIC WIND SOUNDER), VOLUME 2, PHASE 2 Final Report
30 Sep. 1992 294 p Sponsored in part by Hughes Danbury Optical Systems and STI Optronics
(Contract NAS8-37589)
(NASA-CR-184485; NAS 1.26:184485) Avail: CASI HC A13/MF A03

Accurate knowledge of winds is critical to our understanding of the earth's climate and to our ability to predict climate change. Winds are a fundamental component of highly nonlinear interactions between oceans, land surfaces, and the atmosphere. Interactions at these interfaces are the focus of much climate change research. Although wind information is critical for advancing our understanding, currently most of our description of atmospheric motion is obtained indirectly - i.e., derived from observations of temperature and moisture through geostrophic relationships. Direct measurement of winds over the globe is limited to land-based rawinsonde surface stations and a few ship/aircraft reports. Cloud track winds using satellite imagery are calculated but must be used with great care. The LAWS mission objective, therefore, is to provide diurnal and global direct observations of winds - an observation that will incrementally enhance our knowledge of the earth's climate and physical processes responsible for its change. This document is Volume 2 of the LAWS Phase 2 Final Study Report and describes the definition and preliminary design of the LAWS instrument, together with details of the laser breadboard program conducted during the last 18 months of the program. Author

N93-16631# Federal Aviation Administration, Atlantic City, NJ. Technical Center.
AUTOMATED WEATHER OBSERVING SYSTEM (AWOS) DATA ACQUISITION SYSTEM (ADAS) OPERATIONAL TEST AND EVALUATION (OT/E) INTEGRATION AND OT/E OPERATIONAL TEST PLAN
John Barab and Jock Stratton Dec. 1992 68 p
(DOT/FAA/CT-TN90/65) Avail: CASI HC A04/MF A01

The attached document delineates the various plans associated with the preparation and conduct of Operational Test and Evaluation (OT&E) Integration and OT&E Operational testing of the Automated Weather Observing System (AWOS) Data Acquisition System (ADAS) at the Federal Aviation Administration (FAA) Technical Center. It is being circulated to organizations participating in the testing and implementation of the ADAS. Author

N93-16633*# TRW Space Technology Labs., Redondo Beach, CA. Space and Electronics Group.
OBSERVABLES FOR ANTICIPATING TORNADOGENESIS IN MESOCYCLONES Final Report, Jul. 1991 - Nov. 1992
G. Carrier, F. Fendell, J. Mitchell, and M. Bronstein Nov. 1992 60 p
(Contract NAS8-39049)
(NASA-CR-191390; NAS 1.26:191390) Avail: CASI HC A04/MF A01

We seek to identify an observable for anticipating tornadogenesis in mesocyclones, because such tornadoes are characterized by particularly long life, long and wide path, and high wind speed. We associate tornadogenesis with the transition from a one-cell vortex to a two-cell vortex. In such a transition, 'insertion' of a virtually nonrotating, slowly recirculating core displaces that high-swirl-speed air which is rapidly ascending along a moist-adiabatic locus of thermodynamic states, to an annulus at small but finite distance from the axis of rotation. Such a transition, on a vastly larger lateral scale, is known to characterize intensification of a tropical storm to a typhoon. We examine analytically a quasisteady axisymmetric model of a four-part vortex structure consisting of a bulk potential vortex, near-ground inflow layer, 'eyewall', and 'eye'. We inquire whether such a four-part intense vortex, formed in convectively

unstably stratified air, is self-sustaining. In particular, we inquire whether the vertical profile of the angular momentum at the periphery is a discriminant for identifying self-sustaining vortices. Author

N93-16700*# Lockheed Missiles and Space Co., Huntsville, AL.
DESIGN DEFINITION OF THE LASER ATMOSPHERIC WIND SOUNDER (LAWS), PHASE 2. VOLUME 1: EXECUTIVE SUMMARY Final Report, 24 Aug. 1990 - 30 Jun. 1992
Jun. 1992 70 p
(Contract NAS8-37590)
(NASA-CR-191423; NAS 1.26:191423; LMSC-HSV-TR-F320789-1-Vol-1)
Avail: CASI HC A04/MF A01

The LAWS phase 1 and phase 2 studies have been completed on schedule and have led to significant advances in CO2 laser development. The Phase 2 Design Definition Study has shown that a large scanning mirror/high pulse energy laser LAWS Instrument is feasible and within the existing technology. The capability to monitor wind velocities with backscatter ratios of 10(exp 11) m(exp -1) SR(exp -1) is feasible. The weight budget allocated for the baseline LAWS is adequate, and sufficient reserves exist with the potential downsized configuration. With the possible decrease in available power from the baseline of 2.2 kW guideline, power and shot management is critical for the baseline configuration (15 to 20 J). This is particularly true during the 100 day occultation period each year. With the downsized configurations (5 to 7 J), power management is still necessary during the occultation but is primarily limited to shot management over the polar regions. The breadboard effort has produced significant laser advances for a tight 18 month schedule and the minimum budgets available from NASA, Lockheed, and TDS. Using the NASA funds and Lockheed and TDS fixed assets budgets, the breadboard was designed, fabricated, and brought on-line with first laser light within 16 months after ATP. First laser beam was obtained on 21 April 1992 at a 5 J power level. Tests since then have been conducted at sustained, repetitive pulse levels of over 7 J and 20 Hz. This is an increase of over two or three times greater than any system previously developed from this type laser. Increased power levels and additional life tests will be accomplished in the next LAWS phase. The Lockheed LAWS design will operate in the gravity gradient mode on-orbit, and all possible instrument vibration and jitter modes have been considered. Adequate pointing stability and control is state-of-the-art technology for the critical time periods, frequency rates, and control responses required by LAWS. Lockheed recommends a 6-1/2 year phase C/D program for LAWS to provide adequate feedback from the engineering unit and the qualification unit to the final flight unit. Assuming a one year period for LAWS integration to the spacecraft, followed by a six-month period for launch vehicle integration, LAWS could be successfully developed and launched in eight years. Our baseline design or downsized design can be accommodated by either the Atlas 2AS or the Delta launch vehicles. Lockheed's recommendation is that, based on the successful phase 2 design study and breadboard program, a follow-on 18 month extended breadboard testing program and additional system engineering studies, primarily in interfacing with a to be defined platform, be initiated. This should be immediately followed by the phase C/D program, leading to a LAWS launch in late 2001 or early 2002. Author

N93-16702*# Lockheed Missiles and Space Co., Huntsville, AL.
DESIGN DEFINITION OF THE LASER ATMOSPHERIC WIND SOUNDER (LAWS), PHASE 2. VOLUME 2: FINAL REPORT
D. J. Wilson Nov. 1992 213 p
(Contract NAS8-37590)
(NASA-CR-191424; NAS 1.26:191424; LMSC-HSV-TR-F320789-2-Vol-2)
Avail: CASI HC A10/MF A03

Lockheed personnel, along with team member subcontractors and consultants, have performed a preliminary design for the LAWS Instrument. Breadboarding and testing of a LAWS class laser have also been performed. These efforts have demonstrated that LAWS is a feasible Instrument and can be developed with existing state-of-the-art technology. Only a commitment to fund the instrument development and deployment is required to place LAWS in orbit and obtain the anticipated science and operational forecasting benefits. The LAWS Science Team was selected in 1988-89 as were the competing LAWS phase 1/2 contractor teams. The LAWS Science Team developed requirements for the LAWS Instrument, and the NASA/LAWS project office defined launch vehicle and platform design constraints. From these requirements and constraints, the lockheed team developed LAWS Instrument concepts and configurations. A system designed to meet these requirements and constraints is outlined. The LAWS primary subsystem and interfaces - laser, optical, and receiver/processor - required to assemble a lidar are identified. Also identified are the support subsystems required for the lidar to function from space: structures and mechanical, thermal, electrical, and command and data management. The Lockheed team has developed a preliminary design of a LAWS Instrument System consisting of these subsystems and interfaces which will meet the requirements and objectives of the Science Team. This final report provides a summary of the systems engineering analyses and trades of the LAWS. Summaries of the configuration, preliminary designs of the subsystems, testing recommendations, and performance analysis are presented. Environmental considerations associated with deployment of LAWS are discussed. Finally, the successful LAWS laser breadboard effort is discussed along with the requirements and test results. Author

N93-16751*# General Electric Co., Princeton, NJ. Astro Space Div.
DEFINITION AND PRELIMINARY DESIGN OF THE LAWS (LASER ATMOSPHERIC WIND SOUNDER). VOLUME 1, PHASE 2: EXECUTIVE SUMMARY Final Report
30 Sep. 1992 31 p Sponsored in part by Hughes Danbury and STI Optronics
(Contract NAS8-37589)
(NASA-CR-184484; NAS 1.26:184484) Avail: CASI HC A03/MF A01

The objective of phase 1 of the LAWS study was to define and perform a preliminary design for the Laser Atmospheric Wind Sounder (LAWS) instrument. The definition phase consisted of identifying realistic concepts for LAWS and analyzing them in sufficient detail to be able to choose the most promising one for the LAWS application. System and subsystem configurations were then developed for the chosen concept. The concept and subsequent configurations were to be compatible with two prospective platforms--the Japanese Polar Orbiting Platform (JPOP) and as an attached payload on the Space Station Freedom. After a thorough and objective concept selection process, we chose a heterodyne detection Doppler lidar using a CO2 laser transmitter operating at 9.1 microns over a 2.1 micron solid state system. The choice of the CO2 approach over solid-state reflects the advanced state of development of CO2 lasers, its maturity in ground-based systems and the eased subsystem requirements associated with the longer wavelength. The CO2 lidar concept was then analyzed in detail to arrive at a configuration for the instrument and its major subsystems. Our approach throughout the configuration design was to take a systems perspective and trade requirements between subsystems, wherever possible, to arrive at configurations which made maximum use of existing, proven technology or relatively straightforward extensions to existing technology to reduce risk and cost. At the conclusion of Phase 1 we arrived at a configuration for LAWS which meets the performance requirements, yet which is less complex than previous designs of space-based wind sensors (e.g. Windsat), employs lightweight technologies to meet its weight goals (less than 800kg) and sufficiently flexible to offer various operational scenarios with power requirements from about 2 kW to 3 kW. The Phase 1 Final Report was released in March 1990. The 21-month Phase 2 began in October 1990. The requirement to accommodate LAWS as an attached payload on Space Station Freedom was deleted and the orbit altitude for the Japanese polar orbiting platform was changed from 824 km to 705 km. The power allocated to LAWS was reduced to 2.2 kW from 3 kW. Subsequently the availability of a Japanese Polar Orbiting Platform was called into question and LAWS accommodation studies were continued using a conceptual, ATLAS-launched platform supplied by MSFC. In March 1991 a modification to the original contracts was funded to provide a LAWS laser breadboard which could demonstrate all the performance requirements of the LAWS laser. Also funded as part of the same contract extension was a lifetest demonstration using an existing laser at STI. The breadboard extension was an eighteen month effort and the period of performance was therefore extended to September 30, 1992. Author

N93-16836 Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
INVESTIGATIONS OF THE MESOSCALE FLOW IN THE PLANETARY-BOUNDARY-LAYER OVER ISRAEL: A NUMERICAL STUDY M.S. Thesis

Ronen Leiman May 1990 113 p In HEBREW
(ITN-93-85177) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

Three dimensional simulations of meso-scale meteorological processes in the Planetary Boundary Layer (PBL) over Israel were made with NCAR's (MM4) model, in order to investigate the flows in the PBL. Two case studies were simulated: a 'Persian Trough' of 17 June 1987 and a 'Siberian High' of 4 March 1985. In the first case, an intense, sea-breeze circulation develops during the day over the western part of the domain, while over the eastern part, the windfield is defined for most of the day mainly by the thermal gradients caused by the complex topography. The Mediterranean sea-breeze penetrates to the Dead Sea valley by the early evening, causing an intense convergence over the Judean desert. In the second case, the domain can be defined by two different zones: the first zone includes northern Israel and the central and southern mountains. The winds there remain easterly as synoptic winds, throughout the day. The second zone includes the central and southern coast and the northern Negev, where a shallow but by no means negligible, sea-breeze circulation develops with noticeable north-westerly winds. These winds cause a long convergence line when they interact with the easterly flows. A special effort was made to study the diurnal and geographical variance of the PBL depth; a strong connection was found between this depth and the wind and temperature fields inside the PBL. The topographic structure was also found to have a strong influence on the PBL depth. A verification of the surface wind velocity is made by comparing the model results with measurements. It shows that although the model succeeds in simulating correctly the main features of the flow, it does not do quite as well with forecasting the surface velocities. This problem seems to be more significant in the summer case, where the local forcing is much stronger. By incorporating initial observed surface winds, some improvement in the wind forecasting during the first few hours is achieved. Author (ISA)

N93-16953*# Kansas Univ., Lawrence. Radar Systems and Remote Sensing Lab.

RADAR SENSITIVITY AND ANTENNA SCAN PATTERN STUDY FOR A SATELLITE-BASED RADAR WIND SOUNDER (RAWS)

Michael A. Stuart Nov. 1992 144 p
(Grant NAG8-893)
(NASA-CR-191387; NAS 1.26:191387; RSL-TR-9550-2) Avail: CASI HC A07/MF A02

Modeling global atmospheric circulations and forecasting the weather would improve greatly if worldwide information on winds aloft were available. Recognition of this led to the inclusion of the LAser Wind Sounder (LAWS) system to measure Doppler shifts from aerosols in the planned for Earth Observation System (EOS). However, gaps will exist in LAWS coverage where heavy clouds are present. The RAdar Wind Sensor (RAWS) is an instrument that could fill these gaps by measuring Doppler shifts from clouds and rain. Previous studies conducted at the University of Kansas show RAWS as a feasible instrument. This thesis pertains to the signal-to-noise ratio (SNR) sensitivity, transmit waveform, and limitations to the antenna scan pattern of the RAWS system. A dop-size distribution model is selected and applied to the radar range equation for the sensitivity analysis. Six frequencies are used in computing the SNR for several cloud types to determine the optimal transmit frequency. the results show the use of two frequencies, one higher (94 GHz) to obtain sensitivity for thinner cloud, and a lower frequency (24 GHz) to obtain sensitivity for thinner cloud, and a lower frequency (24 GHz) for better penetration in rain, provide ample SNR. The waveform design supports covariance estimation processing. This estimator eliminates the Doppler ambiguities compounded by the selection of such high transmit frequencies, while providing an estimate of the mean frequency. the unambiguous range and velocity computation shows them to be within acceptable limits. The design goal for the RAWS system is to limit the wind-speed error to less than 1 ms(exp -1). Due to linear dependence between vectors for a three-vector scan pattern, a reasonable wind-speed error is unattainable. Only the two-vector scan pattern falls within the wind-error limits for azimuth angles between 16 deg to 70 deg. However, this scan only allows two components of the wind to be determined. As a result, a technique is then shown, based on the Z-R-V relationships, that permit the vertical component (i.e., rain) to be computed. Thus the horizontal wind components may be obtained form the covariance estimator and the vertical component from the reflectivity factor. Finally, a new candidate system is introduced which summarizes the parameters taken from previous RAWS studies, or those modified in this thesis. Author

N93-17054# Los Alamos National Lab., NM.

USING A SECOND-ORDER TURBULENCE RADIATIVE-CONVECTIVE MODEL TO STUDY THE CLOUD/RADIATION INTERACTION WITH THE FIRE DATA

C. Y. J. Kao 1992 5 p Presented at the 4th American Meteorological Society Symposium on Global Change Studies, Anaheim, CA, 14-19 Jan. 1993
(Contract W-7405-eng-36)
(DE93-000678; LA-UR-92-3030; CONF-930142-1) Avail: CASI HC A01/MF A01

It is well recognized that extended sheets of low-level stratus and stratocumulus clouds are a persistent feature over the eastern parts of the major ocean basins associated with the quasipermanent subtropical high-pressure systems. These clouds exert a strong influence on climate through their high albedo, compared with the underlying surface, and their low altitude. The former leads to a reduction of the net incoming shortwave flux into the atmosphere and the latter leads to an infrared loss in a way essentially the same as the cloud-free conditions. Randall et al (1984) estimated that an increase of a few percent of global low-level stratiform clouds may offset the warming caused by a doubling of the atmospheric CO2. The Atmospheric Radiation Measurement (ARM) Program, sponsored by the US Department of Energy, is envisioning a locale in the Eastern North Pacific for extensive measure-ments of stratiform boundary-layer clouds and their interaction with atmospheric radiation. Thus, a physically-based parameterization scheme for marine low-level stratiform clouds can be developed for general circulation models (GCM's). This paper is a modeling study with the current understanding of the important physical processes associated with a cloud-capped boundary layer. The numerical model is a high-resolution one-dimensional version of the second-order turbulence convective/radiative model developed at the Los Alamos National Laboratory. DOE

N93-17074# Argonne National Lab., IL.

STATUS OF INSTRUMENTATION FOR THE SOUTHERN GREAT PLAINS CLOUDS AND RADIATION TESTBED

M. L. Wesely 1991 7 p Presented at the 1991 Atmospheric Radiation Measurement Science Team Meeting, Washington, DC, 28 Oct. 1991
(Contract W-31-109-eng-38)
(DE93-000512; ANL/CP-77379; CONF-9110430-1) Avail: CASI HC A02/MF A01

Planning for the initial complement of instrumentation at the first Clouds and Radiation Testbed (CART) site has concentrated on obtaining a sufficient level of instrumentation at the central facility for studies of radiative transfer processes in a narrow column above the site. The auxiliary facilities, whose sole purpose is cloud mapping above the central facility, will not be activated as such until provisions are made for all-sky imaging systems. In the meantime, the auxiliary facilities will be instrumented as extended facilities if the locations are suitable, which would be the case if they serve the primary purpose of the extended facilities of obtaining representative observations of surface energy exchanges, state variables, precipitation, soil and vegetative conditions, and other factors that must be considered in terms of boundary conditions by single-column and related models. The National Oceanic and Atmospheric Administration (NOAA) radar wind profiler network is being considered to provide observations of vertical profiles at the boundaries of the CART site. If possible, these locations will be used for boundary facilities. Efforts are proceeding to gain access to the wind profiler network data and to determine if a sufficient number of the profilers can be equipped as Radio Acoustic Sounding Systems (RASS). Profiles of temperature as well as winds are needed at the boundary facilities for studies with single-column models and four-dimensional data assimilation models. Balloon-home sounding systems will be used there initially for both temperature and moisture profiles. Infrared spectrometers will eventually be used to infer moisture profiles at these boundary facilities. DOE

N93-17179# Pacific Northwest Lab., Richland, WA.

WINTERTIME METEOROLOGY OF THE GRAND CANYON REGION

C. D. Whiteman Sep. 1992 8 p Presented at the 6th American Meteorological Society Conference on Mountain Meteorology, Portland, OR,

29 Sep. - 2 Oct. 1992
(Contract DE-AC06-76RL-01830)
(DE93-001557; PNL-SA-20898; CONF-9209163-3) Avail: CASI HC A02/MF A01

The Grand Canyon region of the American Southwest is an interesting region meteorologically, but because of its isolated location, the lack of major population centers in the region, and the high cost of meteorological field experiments, it has historically received little observational attention. In recent years, however, attention has been directed to episodes of visibility degradation in many of the US National Parks, and two recent field studies focused on this visibility problem have greatly increased the meteorological data available for the Grand Canyon Region. The most recent and comprehensive of these studies is the Navajo Generating Station Winter Visibility Study of 1989-90. This study investigated the sources of visibility degradation in Grand Canyon National Park and the meteorological mechanisms leading to low visibility episodes. In this paper, we present analyses of this rich data set to gain a better understanding of the key wintertime meteorological features of the Grand Canyon Region. DOE

N93-17180# Pacific Northwest Lab., Richland, WA.
THE COUPLING OF SYNOPTIC AND VALLEY WINDS IN THE TENNESSEE VALLEY
J. C. Doran and C. D. Whiteman Sep. 1992 17 p Presented at the 6th American Meteorological Society Conference on Mountain Meteorology, Portland, OR, 29 Sep. - 2 Oct. 1992
(Contract DE-AC06-76RL-01830)
(DE93-001559; PNL-SA-21181; CONF-9209163-4) Avail: CASI HC A03/MF A01

The interaction of winds in a valley with the winds above the valley is of interest for both practical and theoretical reasons. For example, the forecasting of conditions affecting air quality, emergency preparedness, or aerial spraying of pesticides requires the ability to relate local valley circulations to ambient synoptic conditions. While empirically derived relationships may be useful, it is also desirable to develop an understanding of the mechanisms responsible for the observed behavior. In this paper, we combine results from analyses of measurements and model-generated data to provide insight into factors affecting the climatology of the winds in the Tennessee Valley. We discuss four mechanisms that can determine the behavior of winds in a valley. The conditions can be illustrated in terms of the expected joint frequency distributions of the surface and geostrophic winds. DOE

N93-17372# Wisconsin Univ., Madison. Dept. of Atmospheric and Oceanic Sciences.
PARAMETERIZATION OF GCM SUBGRID NONPRECIPITATING CUMULUS AND STRATOCUMULUS CLOUDS USING STOCHASTIC/PHENOMENOLOGICAL METHODS
R. B. Stull 26 Aug. 1992 9 p
(Contract DE-FG02-92ER-61361)
(DE93-000424; DOE/ER-61361/1) Avail: CASI HC A02/MF A01

A theory was developed for the fraction of near-surface air likely to form forced and active cumulus clouds. This stochastic method is based on a 2-D frequency distribution of the occurrence of various buoyancy and condensation levels in air near the surface, and the relationship of this distribution to the mean temperature profile. An alternative form of this theory utilizes a 2-D distribution of convective available potential energies (CAPE) instead of virtual potential temperatures. DOE

N93-17390# Pacific Northwest Lab., Richland, WA.
BASIN METEOROLOGY, WITH EXAMPLES FROM THE AMERICAN SOUTHWEST (GRAND CANYON REGION) IN WINTER
C. D. Whiteman and K. J. Allwine Sep. 1992 6 p Presented at the 22nd International Conference on Alpine Meteorology, Toulouse, France, 7-11 Sep. 1992
(Contract DE-AC06-76RL-01830)
(DE93-001558; PNL-SA-20711; CONF-9209173-3) Avail: CASI HC A02/MF A01

In winter, deep temperature inversions build up over the floor (approximately 1150 m MSL) of the Colorado Plateaus Basin to the level of the mountain barrier on the basin's western edge (2000-2400 m MSL). During daytime, a convective boundary layer (CBL) grows upward into the base of this inversion from the basin floor. Winter daytime values of sensible heat flux are too small to break the inversion, and the CBL typically grows to depths of only 400-600 m AGL. Nighttime downward sensible heat fluxes extract more heat from the atmosphere than is gained by the atmosphere during daytime, so that the basin inversion persists over long periods and is destroyed only by passing synoptic-scale disturbances. Basin winds are usually weak, and recirculations are frequent features within the basin. Surface flows in the region are often counter to valley wind theory, due to unusual topography in which the prevailing terrain slope is counter to the direction of flow of the Colorado River. DOE

N93-17572# State Univ. of New York, Albany. Atmospheric Sciences Research Center.
USE OF CLOUD OBSERVATIONS AND MESOSCALE METEOROLOGY MODELS TO EVALUATE AND IMPROVE CLOUD PARAMETERIZATIONS
C. J. Walcek 30 Oct. 1992 5 p
(Contract DE-FG02-92ER-61364)
(DE93-003245; DOE/ER-61364/1) Avail: CASI HC A01/MF A01

This research program utilizes satellite and surface-derived cloud observations together with standard meteorological measurements to evaluate and improve our ability to accurately diagnose cloud coverage. Results are to be used to compliment existing or future parameterizations of cloud effects in general circulation models, since nearly all cloud parameterizations must specify a fractional area of cloud coverage when calculating radiative or dynamic cloud effects, and current parameterizations rely on rather crude cloud cover estimates. We have compiled and reviewed a list of formulations used by various climate research groups to specify cloud cover. We find considerable variability between formulations used by various climate and meteorology models, and under some conditions, one formulation will produce a zero cloud amount, while an alternate formulation calculates 95 percent cloud cover under the same environmental conditions. All formulations hypothesize that cloud cover is predominantly determined by the average relative humidity, although some formulations allow local temperature lapse rates and vertical velocities to influence cloud amount. DOE

N93-17597# World Meteorological Organization, Geneva (Switzerland).
ON IMPLEMENTATION (WORLD WEATHER WATCH) Status Report No. 15
1991 106 p
(WMO-753; ISBN-92-63-10753-X; ETN-92-92608) Copyright Avail: CASI MF A02; print copy available at WMO, Geneva, Switzerland

The World Weather Watch (WWW) plan forms an integral part of the WMO's (World Meteorological Organization) Second Long Term Plan (SLTP). Conclusions commenting on its status of implementation with reference to the SLTP are given. The purpose of the program plan is to give members a conceptual framework for their participation in the WWW and the further long term development of their national meteorological services. The guidelines given by the plan are based on developments in meteorological operational techniques and technological advances, with an assessment of their suitability to day to day operation of meteorological services. The objectives, services, system support activity, implementation objectives, and activities of the WWW program plan for 1988-1997 are discussed. Particular attention is given to: the global observing system; the global data processing system; the global telecommunication system; WWW data management, including monitoring of the operation of the WWW; and the WWW operational information service. ESA

N93-17658# Oceanweather, Inc., Cos Cob, CT.
UNIFIED PROGRAM FOR THE SPECIFICATION OF HURRICANE BOUNDARY LAYER WINDS OVER SURFACES OF SPECIFIED ROUGHNESS Final Report
Vincent J. Cardone, Catherine V. Greenwood, and J. A. Greenwood Sep. 1992 205 p
(Contract DACW39-78-C-0100)
(AD-A257462; CERC-92-1) Avail: CASI HC A10/MF A03

A method is developed to specify the surface stress and the wind speed and direction in the planetary boundary layer of a tropical cyclone from meteorological storm parameters available for historical hurricanes. The method is based upon a numerical primitive-equation model of the planetary boundary layer in a moving tropical cyclone. The complete time history of the evolution of the surface wind field is described from a series

of characteristic wind field states calculated at discrete times in a storm's history by the steady-state model. A surface drag formulation, based upon a contemporary similarity model (Arya 1977), coupled with a toughness parameter specification for a water surface consistent with Cardone's (1969) law, is incorporated into the numerical model and found to produce a consistent description of the integrated planetary boundary layer wind, the surface stress and its direction, and the wind speed and direction at anemometer level. The surface winds calculated in several recent hurricanes are found to be in excellent agreement with available, representative surface wind measurements made from offshore platforms and data buoys. Transformations based upon an equilibrium planetary-boundary-layer similarity model are developed to specify the surface wind over terrain of specified roughness, including lake surfaces, from the over-water wind-field solution. Calculated over-land and over-lake winds are compared to the limited measurements available for several recent storms. GRA

N93-17668# Naval Postgraduate School, Monterey, CA.
INCORPORATION OF A RADIATION PARAMETERIZATION SCHEME INTO THE NAVAL RESEARCH LABORATORY LIMITED AREA DYNAMICAL WEATHER PREDICTION MODEL M.S. Thesis
Paul C. Stewart Sep. 1992 76 p
(AD-A257739) Avail: CASI HC A05/MF A01

This paper describes the incorporation of the Harshvardhan et al. (1987) radiation parameterization into the Naval Research Laboratory Limited Area Dynamical Weather Prediction Model. A comparison between model runs with the radiation scheme and runs without the scheme was made to examine three mesoscale phenomena along the west coast of the United States during the period 0000 UTC 02 May 1990 - 1200 UTC 03 May 1990: the land and sea breeze, the southerly surge, and the Catalina eddy. In general, the updated model with the radiation parameterization yielded a more accurate simulation of the layer temperatures, geopotential heights, cloud cover, and radiative processes as verified from synoptic, mesoscale, and satellite observations. Subsequently, the updated model also forecast a more realistic diurnal evolution of the sea and land breeze, the southerly surge, and the Catalina eddy. GRA

N93-17678# Air Force Environmental Technical Applications Center, Scott AFB, IL.
CLOUD MODEL DATABASE COMPARISON STUDY Project Report
Kirk D. Poore Aug. 1992 60 p
(AD-A258065; USAFETAC/PR-92/004) Avail: CASI HC A04/MF A01

This report documents the results of a study that examined and compared the Air Force Global Weather Central's (AFGWC's) climatological cloud model databases: the Real-Time Nephanalysis (RTNEPH) and the Three-Dimensional Nephanalysis (3DNEPH). The study investigates their characteristics, determines the length of a climatologically sound period of record (POR), finds a year with typical cloud cover for use as a baseline in future studies, and weighs the advantages and disadvantages of Multipurpose Simulator (MRS) databases derived from the RTNEPH and 3DNEPH. The older 3DNEPH cloud model, first used in the 1970's, produced worldwide, layered cloud analyses on a 25-NM grid. RTNEPH replaced 3DNEPH at the beginning of 1984. GRA

N93-17679# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
THE KINEMATIC STRUCTURE OF A PREFRONTAL CONVECTIVE RAINBAND REVEALED BY TAMEX DOPPLER RADAR DATA M.S. Thesis
Michael J. Miglioranzi 1992 128 p
(AD-A258081; AFIT/CI/CIA-92-107) Avail: CASI HC A07/MF A02

In this study, the kinematic features of a subtropical convective rainband in association with Mei-Yu front on 25 June 1987 over northern Taiwan is investigated. This front caused heavy rainfall due to its slow movement (2.5 m/s) and orientation. CP-4 Doppler radar was used to collect information about this storm during TAMEX IOP-13. Fields of reflectivity, winds, radial velocity, vertical velocity, and divergence are displayed over six time periods during a 40-minute time span. GRA

N93-17680# Naval Postgraduate School, Monterey, CA.
UPPER-TROPOSPHERIC FORCING OF THE INTENSIFICATION RATES OF TROPICAL CYCLONES FLO AND ED BASED ON TCM-90 OBSERVATIONS M.S. Thesis
Jeff H. Rucker Jun. 1992 202 p
(AD-A257659) Avail: CASI HC A10/MF A03

A case study of the upper-tropospheric forcing of the intensification rates of typhoons Flo and Ed has been accomplished. High-resolution, hand-drawn streamline analyses of the 150, 200, 250, and 300 mb winds from the final observational data set of the Tropical Cyclone Motion (TCM-90) field experiment were constructed for 00, 06, 12, and 18 UTC during the period 00 UTC 12 September through 00 UTC 19 September 1990. Three basic interaction mechanisms that appeared to have major roles in upper-level forcing on Flo and Ed were defined. Outflow layer changes were quantified through calculation of the mass divergence and eddy flux convergence of relative angular momentum using a radial-band averaging technique at 200 mb. A nearly 1:1 qualitative relationship was found to exist between the development of one or more of these mass/heat export mechanisms and corresponding changes in the intensification rates. These calculations from the best-ever typhoon region data set strongly suggest that upper-level forcing leads the intensification process by 12-24 h. GRA

N93-17701# Coherent Technologies, Inc., Boulder, CO.
COHERENT LIDAR SYSTEM FOR HIGH RESOLUTION MEASUREMENT OF ATMOSPHERIC WIND VELOCITY AND WATER VAPOR FIELDS Final Report, 1 Feb. - 31 Jul. 1992
J. A. Thomson, Stephen M. Hannon, Paul J. Suni, and R. M. Huffaker Jul. 1992 67 p
(Contract DAAL03-92-C-0004)
(AD-A257725; CTI-TR-9206; ARO-29496.1-GS-SBI) Avail: CASI HC A04/MF A01

The objective of this study is to evaluate the capability for a scanning coherent pulsed laser to acquire high resolution, time dependent mapping of the three dimensional structure of wind velocity and water vapor in the turbulent boundary layer. Power, pulse length, prf, and sampling requirements have been established that will permit achievement of 25 to 50 meter 3D spatial resolution with better than 1 meter/second velocity resolution throughout a 3 cubic kilometer volume of boundary layer in a 5 second update time using near term 1 or 2 micron laser systems. Signal processing techniques are outlined (and demonstrated with simulations) that can merge line-of-sight wind component measurements from a single station laser radar with multi-dimensional boundary layer dynamic models to retrieve the full vector wind field. Simultaneous DIAL measurements (at 2 microns laser wavelength) can be used to measure large scale water vapor fluctuations. A correlation technique to infer small scale water vapor fluctuations fields from observations of the more readily detected fluctuations of backscatter intensity is proposed. Data taken with two available scanning lidars (1 and 2 microns wavelength) is presented to demonstrate the spatial resolutions achievable. A program for implementing a full 3D demonstration measurement is outlined. GRA

N93-17744# Air Force Global Weather Central, Offutt AFB, NE.
COMPUTER MODELS USED BY AFGWC AND NMC FOR WEATHER ANALYSIS AND FORECASTING
Richard J. Conklin Aug. 1992 79 p
(AD-A257985; AFGWC/TN-92/001) Avail: CASI HC A05/MF A01

Described are the numerical analysis and forecast models most widely used by U.S. Air Force meteorologists. These models are: the Air Force Global Weather Central (AFGWC) Global Spectral Model (GSM) the AFGWC Real-Time Nephanalysis (RTNEPH); the AFGWC High Resolution Analysis (HIRAS) models; the AFGWC Five-Layer cloud forecast model (5-LAYER); the National Meteorological Center (NMC) Nested Grid Model (NGM); and the NMC Aviation/Medium Range Forecast (AVN/MRF) model. This report also describes model grids and tells how the grids are built. Strengths and weaknesses of the various models are discussed, along with AFGWC and NMC production cycles. GRA

N93-17785# California Univ., Santa Barbara.
MULTIFRACTAL CLOUD PROPERTIES DATA ASSESSMENT
C. Gautier, P. Ricchiazzi, P. Peterson, D. Lavallee, R. Frouin, D. Lubin (California Univ., San Diego.), S. Lovejoy (McGill Univ., Montreal, Quebec), and D. Schertzer May 1992 15 p
(Contract DE-FG03-90ER-61062)
(DE93-002638; DOE/ER-61062/T1) Avail: CASI HC A03/MF A01

Our group has been very active over the last year, analyzing a number of data sets to characterize multifractal cloud properties and assess the

effects of clouds on surface radiation properties (spectral and broadband). The data sets analyzed include: AVHRR observations of clouds over the ocean, SPOT observations of clouds over the ocean, SSM/I observations of clouds over the ocean, pyranometer data with all-sky photographs, pyrgeometer data all-sky photographs, and spectral surface irradiance all-sky photographs. A number of radiative transfer computations have been performed to help in the interpretation of these observations or provide theoretical guidance for their analysis. Finally 4 number of radiative transfer models have been acquired and tested to prepare for the interpretation of ARM/CART data. DOE

N93-17285*# Columbia State Community Coll., TN. Dept. of Computer Information Systems.
INVESTIGATION OF RAINFALL DATA WITH REGARD TO LOW-LEVEL WIND FLOW REGIME FOR EAST CENTRAL FLORIDA
Joni Brooks *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17292*# Oklahoma Univ., Norman. School of Meteorology.
A PLAN FOR ACCURATE ESTIMATION OF DAILY AREA-MEAN RAINFALL DURING THE CAPE EXPERIMENT
Claude E. Duchon *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N93-15695*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A COMPUTER PROGRAM FOR PREDICTING OCEANIC TIDAL CURRENTS
D. E. Cartwright (Hughes STX, Inc., Lanham, MD.), R. D. Ray (Hughes STX, Inc., Lanham, MD.), and B. V. Sanchez Washington Dec. 1992 26 p
(NASA-TM-104578; NAS 1.15:104578) Avail: CASI HC A03/MF A01

A computer model is developed for predicting depth-averaged tidal currents from a high-degree spherical harmonic expansion of the elevation field for any diurnal or semidiurnal harmonic constituent. Local friction is ignored, but loading and self-attraction potentials are fully allowed for by use of sequences of Love numbers. Critical latitudes for diurnal tides are covered by direct evaluation of the cyclonic component of current, and linear interpolation of the anti-cyclonic component within plus or minus 5 degrees of latitude. Results agree reasonably well with selected measurements of M2 currents and with M2 currents computed within Schwiderski's model. However, the Cartwright-Ray model apparently gives noisier results for M2 and is unacceptably noisy for diurnal constituents. Predictions from either model become unreliable within about 500 km of the coast, but in the open ocean use of our method applied to the Schwiderski maps probably yields a prediction accuracy in the region 5-10 mm/s. Author

N93-15807# Lawrence Livermore National Lab., CA.
BEHAVIOR OF AN OCEAN GENERAL CIRCULATION MODEL AT FOUR DIFFERENT HORIZONTAL RESOLUTIONS
C. Covey Aug. 1992 32 p
(Contract W-7405-eng-48)
(DE93-001341; UCRL-ID-111564; PCMDI-4) Avail: CASI HC A03/MF A01

A global ocean general circulation model is used to simulate the present-day ocean climate using four different latitude/longitude grid spacings. Horizontal resolution varies from 1/2 deg x 1/2 deg--the highest attained to date in an ocean circulation model with global coverage--to a coarse 4 deg x 4 deg grid traditionally used in climate modelling. This study addresses the question of whether resolution of smaller-scale circulations is necessary in order to simulate the large-scale ocean climate correctly. Results indicate that large-scale circulation is rather sluggish at 4 deg x 4 deg resolution but surprisingly insensitive to grid spacing for resolutions better than 2 deg x 2 deg, even considering the constraints imposed on the model by surface boundary conditions and by 'robust diagnostic' forcing near the poles and below the thermocline. Simulated transport of heat from the warm tropics to cooler higher latitudes is not overly sensitive to grid spacing for resolutions better than 2 deg x 2 deg. Furthermore, heat transport does not increase at 1/2 deg x 1/2 deg resolution when sub-gridscale mixing of heat and momentum are altered so that mesoscale eddies appear in the model. These results support inferences from earlier studies (based on simplified, limited-domain circulation models) that mesoscale eddies make little net contribution to poleward heat transport by the oceans. They suggest that for global climate modeling, the substantial computer resources required to explicitly resolve ocean mesoscale eddies might be better spent on improving emulations of other components of the climate system. Making this conclusion definite, however, requires a global ocean simulation that is fully eddy-resolving and that relaxes the artificial constraints of the present simulation, which tend to force the results toward present ocean climatology. DOE

N93-15843# Army Cold Regions Research and Engineering Lab., Hanover, NH.
PHYSICAL AND DYNAMIC PROPERTIES OF SEA ICE IN THE POLAR OCEANS
Anthony J. Gow and Walter B. Tucker, III Sep. 1991 53 p
(DA Proj. 4A1-61102-AT-24)
(AD-A256303; CRREL-Mono-91-1) Avail: CASI HC A04/MF A01

This monograph provides a current review of the state of knowledge of the growth, properties, and small- and large-scale behavior of sea ice found in the polar oceans of the northern and southern hemispheres. A major focus of the report is to contrast and compare the physical and dynamic properties of ice found in the Arctic seas with those found in the seas surrounding the Antarctic continent. Very significant differences in the physical and dynamic properties of the ice are shown to exist that derive directly from differences in land-sea relationships between the two polar regions and their effect on ocean-atmosphere interaction and oceanic circulation. The same factors also determine, to a large degree, major differences in the seasonal distribution and extent of sea ice in the Arctic and Antarctic oceans. GRA

N93-16024# Woods Hole Oceanographic Inst., MA.
MERIDIONAL CIRCULATION IN THE TROPICAL NORTH ATLANTIC
M.S. Thesis
Marjorie A. Friedrichs Sep. 1992 72 p Sponsored by ONR
(AD-A256906) Avail: CASI HC A04/MF A01

A transatlantic CTD/ADCP section nominally located at 11 deg N was carried out in March 1989. In this paper relative geostrophic velocities are computed from these data via the thermal wind balance, with reference level choices based primarily on water mass distributions. Mass is conserved by requiring the geostrophic transport to balance the sum of the Ekman and shallow western boundary current transports. A brief overview of the meridional circulation of the upper waters resulting from these analysis techniques is presented, and indicates a North Brazil Current transport of nearly 12 Sv. Transports of the shallow waters are found to support the results of Schmitz and Richardson (1991) who found nearly half of the Florida Current waters to be derived from the South Atlantic. Schematic circulation patterns of the NADW and AABW are also presented. The deep waters of the western basin are dominated by a cyclonic recirculation gyre, consisting of a southward DWBC transport of 26.5 + or - 1.8 Sv, with nearly half of this flow returning northward along the western flank of the MAR. A particularly notable result of the deep western basin analysis is the negligible net flow of middle NADW. Although the northward flows of upper and lower NADW along the western flank of the MAR are believed to be associated with the local recirculation gyre, the northward flow of middle NADW, which nearly balances the southward flow of this water mass along the western boundary, may be derived from the eastern basin of the South Atlantic. GRA

N93-16075# Naval Academy, Annapolis, MD.
THE BEHAVIOR AND DISSOLUTION OF GAS BUBBLE CLOUDS IN AN OCEAN ENVIRONMENT Final Report, 1991 - 1992
William T. Shaffer 8 May 1992 43 p
(AD-A257131; USNA-TSPR-198) Avail: CASI HC A03/MF A01

The absorption process is examined of carbon dioxide into both fresh water and seawater. The project investigated the factors which affect the dissolution of CO2 including the concentration gradient between the gas bubble and water, the relative velocity of the bubble with respect to the water, and the combined surface area of carbon dioxide bubbles in contact with the water. A six foot plexiglas tower was used to create a water column through which gas bubbles were percolated. The pH change of the water was measured at both the inlet and outlet of the tower. The amount of dissolved gas was determined by using the first dissociation constant and the concentration of H+ ions in the water. Three series of data were taken. Overall, it was found that water has the ability to absorb CO2 and further study in this field is recommended GRA

N93-16076# Naval Academy, Annapolis, MD.
INVESTIGATION OF ANTARCTIC SEA ICE CONCENTRATION BY MEANS OF SELECTED ALGORITHMS Final Report, 1991 - 1992
Andrew S. Lomax 8 May 1992 102 p
(AD-A257132; USNA-TSPR-188) Avail: CASI HC A06/MF A02

Changes in areal extent and concentration of sea ice around Antarctica may serve as sensitive indicators of global warming. A comparison study was conducted between the outputs of the three main algorithms currently in use (NASA Team, Comisco, and NORSEX) and a sea-ice model (Fine Resolution Antarctic Model). Data from the DMSP Special Sensor Microwave/Imager (SSM/I) were used as input algorithms for the time frame July, 1987 to June, 1990. Large disparities are apparent when comparing the NASA algorithm with the Comisco and NORSEX algorithms. Very large differences, some higher than 30 pct, exist in the marginal ice zones, along the coast, and in the Weddell and Ross Seas. Heat fluxes through recurring polynyas were calculated to quantify further differences in the algorithms; however, no conclusive patterns were apparent. No significant change in the extent or area of the ice pack occurred from July, 1987 through June, 1990. GRA

N93-16083# Woods Hole Oceanographic Inst., MA.
BIBLIOGRAPHY OF TECHNICAL REPORTS, 1991 FROM WOODS HOLE INSTITUTION
Susan S. Berteaux Jul. 1992 14 p
(AD-A257304; WHOI-92-28) Avail: CASI HC A03/MF A01

The technical reports prepared by the Woods Hole Oceanographic Institution in 1991 are listed in this bibliography. Inquiries about availability of extra copies will be handled on an individual basis. Initial distribution of the reports is controlled by the funding agencies. Reports are available through the: National Technical Information Service, NTIS Order Desk, 5285 Port Royal Road, Springfield, VA 22161. NTIS order numbers are included with each report listed, or can be obtained through the Document Library. GRA

N93-16125# Naval Postgraduate School, Monterey, CA.
DEFINITION OF THE SEA SURFACE INFRARED SUN GLITTER CORRIDOR M.S. Thesis
Eric B. Moss Sep. 1992 154 p
(AD-A257100) Avail: CASI HC A08/MF A02

Measurements of sea surface radiance were made in the 2-5.6 and 8-14 micrometers wavebands within patterns of intense specular highlights formed near the azimuth of the sun at low solar observation angles. From these measurements, an analysis of the statistical and physical nature of a sun glitter channel as presented to a low altitude observer (i.e. shipboard) was conducted. Findings showed strong correlations between wind speed and corridor width, and between wind speed and the strength of source radiance, dominated primarily by the direct solar reflected contribution to sea radiance. 8-14 micrometer radiances showed far less susceptibility to the detrimental effects of sun glitter on IR sensing systems. All patterns were Gaussian in shape across the azimuthal extent of each glitter corridor. The magnitude of glinting radiances decreased with increasing depression angles, presenting an approximate half Gaussian radiance distribution in elevation. A method to convert apparent radiance (as received at the sensor) to equivalent zero-range blackbody source radiance was formulated but showed weaknesses in computing the path radiance of the atmosphere intervening between the sea and the AGA 780 sensor, and in accounting for the emissivity of the sea surface as it affected the self-emitted component of sea surface source radiance. GRA

N93-16294# Columbia Univ., Palisades, NY. Geological Observatory.
MEASUREMENTS OF CARBON DIOXIDE IN THE SOUTHERN OCEAN ALONG THE WOCE S-4 SECTION
D. W. Chipman, S. I. Rubin, and T. Takahashi Aug. 1992 8 p
(Contract DE-FG02-92ER-61397)
(DE92-040334; DOE/ER-61397/1) Avail: CASI HC A02/MF A01

The data acquisition phase was completed at sea along the WOCE-S4 section located along 67 deg S between 73 deg W and 172 deg E in the Pacific sector of the Southern Ocean. The expedition was carried out aboard the Russian Research Ship 'Akademik IOFFE' during 14 Feb. to 6 Apr. 1992. The total CO2 concentration and pCO2 in a total of about 1290 water samples were determined using a coulometer for total CO2 and an equilibrator/gas chromatograph system for pCO2. Surface water samples were analyzed at all the 112 hydrographic stations occupied. Complete or partial profiles were obtained at 58 stations. In addition, a total of 172 determinations were made at sea for 62 bottles of the Standard Reference Solution. DOE

N93-16483 Department of the Navy, Washington, DC.
UNDERSEA DATA COLLECTION, ANALYSIS, AND DISPLAY SYSTEM Patent
Erik Chaum, inventor (to Navy) 30 Jun. 1992 13 p Filed 23 Apr. 1991
(AD-D015476; US-Patent-5,126,978; US-Patent-Appl-SN-691581; US-Patent-Class-367-135) Avail: US Patent and Trademark Office

A device and process is disclosed for creating detailed volumetric ocean models, which in turn are used as inputs for naval tactical and oceanographic analysis. Near-real-time volumetric modelling is accomplished by continuously integrating, filtering, interpolating, and extrapolating oceanographic data (e.g., temperature, sound velocity, conductivity, salinity, bathymetry, current, chlorophyll) from historical data bases, forecasts, remote sensors, and onboard sensors. The value of the invention can be appreciated in the detailed, time-varying, three-dimensional ocean models which can be realized for mesoscale and smaller areas and the ability to use these more detailed and timely ocean models for three-dimensional acoustic propagation predictions and combat control algorithms. Tactical and oceanographic models are computed using an advanced processor and the results are displayed using three-dimensional visualization software and hardware techniques. The invention may be used from a submarine, surface ship, or aircraft. GRA

N93-16574# Beleidscommissie Remote Sensing, Delft (Netherlands).
MORPHODYNAMICS OF INTERTIDAL REGIONS [MORFODYNAMICA VAN INTERTIJDEGEBIEDEN]
A. J. F. vanderSpek (Rijks Geologische Dienst, Haarlem, Netherlands) and H. H. S. Noorbergen (National Aerospace Lab., Emmeloord, Netherlands) Apr. 1992 64 p In DUTCH
(BCRS Proj. TO-2.18)
(BCRS-92-03; ISBN-90-5411-039-2; ETN-93-92848) Avail: CASI HC A04/MF A01

The usefulness of satellite LANDSAT MSS (Multi Spectral Scanner) pictures for the morphodynamics study of the intertidal region of the Dutch Wadden Sea (Shallows) was investigated. For the comparison of satellite pictures a good control of the water levels at the moment of the pictures is necessary. The MSS band 7 makes the best discrimination between water and land. In the period from 1975 to 1987 changes in the tidal inlets between Terschelling and Ameland, and between Ameland and Schiermonikoog, are remarklable. Terschelling became about 2 km shorter, while Ameland grew by about 1 km on the east direction. Both processes form part of a cyclic evolution and are accompanied by radical changes in the channel systems and dead waters. ESA

N93-17662# Naval Postgraduate School, Monterey, CA.
THERMODYNAMIC AIR/OCEAN FEEDBACK MECHANISMS IN THE EQUATORIAL PACIFIC M.S. Thesis
Robert S. Steadley Sep. 1992 105 p
(AD-A257476) Avail: CASI HC A06/MF A02

The occurrence of the El Nino Southern Oscillation (ENSO) has been studied from numerous air-ocean interaction aspects, yielding theories implying a positive-only correlation between the time rate of change of sea surface temperature anomaly (DT's/Dt) and the corresponding change in the depth of the ocean mixed layer (h'). However, an alternate proposal by Chu (1991a,b, 1992) holds that there are both positive and negative correlations between aTs/t and h'. Chu's proposal, based upon the modified Kraus-Turner ocean mixed layer (OML) thermodynamic model, goes further to say that the regions occupied by these positive and negative correlation values correspond roughly to those occupied by positive and negative values of a surface forcing function, P, that is an indication of the strength of the counteracting surface forcings of wind work and buoyant damping. The model-generated fields of surface wind stress, net heat flux, sea surface temperature, and primary (mixed) layer depth are analyzed for a two year ENSO event, 1986 - 87, covering the region of the equatorial Pacific, 10N to 10S and to 140E to 80W, in order to determine the validity of these theories. The results shows a fairly uniform P-field over the entire period, consisting of a negative P-field (indicative of a shallowing regime) in most of the western Pacific and in the far eastern part of the eastern Pacific with a positive P-field (indicative of an entrainment regime) in between. GRA

N93-17737# Woods Hole Oceanographic Inst., MA.
HYDROGRAPHIC DATA FROM ENDEAVOR 214: A STUDY OF THE GULF STREAM-DEEP WESTERN BOUNDARY CURRENT CROSSOVER
Robert S. Pickart, Theresa K. McKee, and William M. Smethie, Jr. May 1992 131 p
(Grant NSF OCE-90-09464)
(AD-A257966; WHOI-92-23) Avail: CASI HC A07/MF A02

In late June, 1990, a 17-day cruise aboard R/V ENDEAVOR was undertaken to investigate the manner in which the Deep Western Boundary Current (DWBC) crosses under the Gulf Stream. Forty-four CTD casts, comprising five sections, were made along with bottle measurements of Dissolved Oxygen, Nitrate, Nitrite, Phosphate, Silica, F-11, and F-12. An acoustic transport float (POGO) was deployed at each station to obtain a measurement of the upper layer transport. The shipboard Acoustic Doppler Current Profiler (ADCP) measured currents throughout the cruise. This report presents vertical profiles and sections of the bottle and CTD data, a vector map of the average POGO currents, and listings of the bottle data. GRA

51 LIFE SCIENCES (GENERAL)

N93-15823*# Office of Space Science and Applications, Washington, DC.
STS-40 SPACELAB LIFE SCIENCES 1 (SLS-1): THE FIRST DEDICATED SPACELAB LIFE SCIENCES MISSION
May 1991 54 p Original contains color illustrations
(NASA-TM-108034; NAS 1.15:108034; STS-40) Avail: CASI HC A04/MF A01; 20 functional color pages

Successful exploration of space depends on the health and well-being of people who travel and work there. For this reason, the National Aeronautics and Space Administration (NASA) has dedicated several Space Shuttle missions to examine how living and working in space affects the human body. Spacelab Life Sciences 1 (SLS-1) is the first of these missions. The main purpose of the SLS-1 mission is to study the mechanisms, magnitudes, and time courses of certain physiological changes that occur during space flight and to investigate the consequences of the body's adaptation to microgravity and readjustment to gravity upon return to Earth. How does space flight influence the heart and circulatory system, metabolic processes, the muscles and bones, and the cells? If responses to weightlessness are undesirable, how can they be prevented or controlled? Will the human body maintain its physical and chemical equilibrium during months aboard a space station and years-long missions to Mars? When crews return to Earth, what can they expect to experience as their bodies readjust to Earth's gravity? With the SLS-1 experiments, NASA is addressing some of these questions. Various aspects of the SLS-1 are discussed. Author

N93-15965# Armed Forces Radiobiology Research Inst., Bethesda, MD.
AFRRI REPORTS Technical Report, Jul. - Sep. 1992
Oct. 1992 93 p
(AD-A257231; AFRRI-SR92-27; AFRRI-SR92-28) Avail: CASI HC A05/MF A01

This volume contains AFRRI Scientific Reports SR92-27 through SR92-38 for July-September 1992. Contents: Peroxide effects on (3H)L-glutamate release by synaptosomes isolated from the cerebral cortex; Effect of prostaglandins, inositol 1,4,5-trisphosphate, and phorbol esters on radiation-induced decrease in calcium influx in rat brain synaptosomes; Surgical and pharmacological dissociation of cardiovascular and emetic responses to intragastric CuSO; Increased resistance to ionizing and ultraviolet radiation in Escherichia coli JM83 is associated with a chromosomal rearrangement; Cisplatin-induced conditioned taste aversion--attenuation by dexamethasone but not zacopride or GR38032F; Role of glutathione in repair of free radical damage in hippocampus in vitro; Is all radiation-induced emesis ameliorated by 5-HT3 receptor antagonists?; Emesis in ferrets following exposure to different types of radiation-- a dose-response study; Radioprotection by vitamin E--injectable vitamin E administered alone or with WR-3689 enhances survival of irradiated mice; Application of high-performance liquid chromatography assay for monitoring kinetics of interconversions of stereoisomers of thymidine glycol; Effects of interleukin-1 on the stress-responsive and -nonresponsive subtypes of corticotropin-releasing hormone neurosecretory axons; and The hypothalamo-pituitary-adrenal axis in rodents--corticotropin releasing hormone/vasopressin co-existence and cytokine effects. GRA

N93-16799*# National Aeronautics and Space Administration, Washington, DC.
BIOMEDICAL POLAR RESEARCH WORKSHOP MINUTES
11 Oct. 1990 137 p Workshop held in Washington, DC, 11-12 Oct. 1990 Prepared in cooperation with National Science Foundation, Washington, DC
(NASA-TM-108026; NAS 1.15:108026) Avail: CASI HC A07/MF A02

This workshop was conducted to provide a background of NASA and National Science Foundation goals, an overview of previous and current biomedical research, and a discussion about areas of potential future joint activities. The objectives of the joint research were: (1) to develop an understanding of the physiological, psychological, and behavioral alterations and adaptations to extreme environments of the polar regions; (2) to ensure the health, well-being, and performance of humans in these environments; and (3) to promote the application of biomedical research to improve the quality of life in all environments. For individual titles, see N93-16800 through N93-16808.

N93-16800*# National Aeronautics and Space Administration, Washington, DC.
EPIDEMIOLOGIC RESEARCH IN ANTARCTICA
In its Biomedical Polar Research Workshop Minutes 11 Oct. 1990 22 p Prepared in cooperation with National Science Foundation, Washington, DC (For primary document see N93-16799 05-51)
Avail: CASI HC A03/MF A02

A study of epidemiology of respiratory viruses that was begun in the early 1960's is described. Locations selected for the study included a Wisconsin University housing village, a second grade school population, individual volunteers who associated socially, married couples, and the winter-over population at McMurdo Bay and at Scott Base in the Antarctic. It was concluded that most rhinovirus transmission is through aerosolized particles. Air filtration and careful nasal sanitation with virucidal tissues are determined to be effective in blocking rhinovirus transmission and should be useful in both isolated space colonies and in ordinary earth-bound populations. J.P.S.

N93-16801*# National Aeronautics and Space Administration, Washington, DC.
SUMMARY OF PRESENTATION FOR RESEARCH ON SOCIAL STRUCTURE, AGREEMENT, AND CONFLICT IN GROUPS IN EXTREME AND ISOLATED ENVIRONMENTS **c53**
In its Biomedical Polar Research Workshop Minutes 11 Oct. 1990 1 p (For primary document see N93-16799 05-51)
Avail: CASI HC A01/MF A02

Despite a vast amount of research, little is known concerning the

effect of group structure, and individuals' understanding of that structure, on conflict in Antarctic groups. The overall objective of the research discussed is to determine the interrelationships of group structure, social cognition, and group function and conflict in isolated and extreme environments. In the two decades following WWII, a large body of research focused on the physiological, psychological, and social psychological factors affecting the functioning of individuals and groups in a variety of extreme and isolated environments in both the Arctic and Antarctic. There are two primary reasons for further research of this type. First, Antarctic polar stations are considered to be natural laboratories for the social and behavioral sciences and provide an opportunity to address certain theoretical and empirical questions concerned with agreement and conflict in social groups in general and group behavior in extreme, isolated environments in particular. Recent advances in the analysis of social networks and intracultural variation have improved the methods and have shifted the theoretical questions. The research is motivated by three classes of questions: (1) What are the characteristics of the social relations among individuals working and living together in extreme and isolated environments?; (2) What do individuals understand about their group, how does that understanding develop, and how is it socially distributed?; and (3) What is the relationship between that understanding and the functioning of the social group? Answers to these questions are important if we are to advance our knowledge of how individuals and groups adapt to extreme environments. Second, although Antarctic winter-over candidates may be evaluated as qualified on the basis of individual characteristics, they may fail to adapt because of certain characteristics of the social group. Consequently, the ability of winter-over-groups to adapt to these extreme conditions has varied dramatically from year to year. In the past, differences in personality, background, and social status have led to conflicts between individuals or cliques precipitating, in turn, an overall decline in morale, failure to accomplish work tasks, and increases in insomnia, depression, anxiety, and alcohol abuse. A better understanding of the role of group structure and social cognition in processes of group adaptation and conflict in Antarctica would contribute towards the revision of existing screening methods, potentially leading to a reduction of group conflict and improved performance of scientific research and support activities. An improved screening protocol for the Antarctic would also have applications for other isolated environments such as scientific outposts and the proposed NASA space station. In sum, this research will (1) contribute significantly to our theoretical understanding of the role of social structure and cognition in the functioning of groups in isolation; (2) complement current work on health and adaptation in polar environments; and (3) provide for models of the formation of group structure that will aid in the development of improved procedures for assembling groups for the Antarctic and other isolated environments (e.g., space stations). Author

N93-16802*# National Aeronautics and Space Administration, Washington, DC.

NASA/NSF ANTARCTIC SCIENCE WORKING GROUP

Janis H. Stoklosa *In its* Biomedical Polar Research Workshop Minutes 11 Oct. 1990 11 p (For primary document see N93-16799 05-51)

Avail: CASI HC A03/MF A02

A collection of viewgraphs on NASA's Life Sciences Biomedical Programs is presented. They show the structure of the Life Sciences Division; the tentative space exploration schedule from the present to 2018; the biomedical programs with their objectives, research elements, and methodological approaches; validation models; proposed Antarctic research as an analog for space exploration; and the Science Working Group's schedule of events. J.P.S.

N93-16803*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

NASA/NSF WORKSHOP ON ANTARCTIC RESEARCH

Mary M. Connors *In* NASA. Headquarters, Biomedical Polar Research Workshop Minutes 11 Oct. 1990 8 p (For primary document see N93-16799 05-51)

Avail: CASI HC A02/MF A02

Viewgraphs that accompanied an Ames Research Center presentation address Ames' currently-supported life sciences activities. These include crew factor issues such as human, automation, and telecommunication systems; strategic behavior and workloads; sleep, fatigue, and circadian rhythms; and virtual reality and spatial instrumentation. The need, background, and examples of pertinent research are provided. J.P.S.

N93-16804*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

INFECTIOUS DISEASE

Duane L. Pierson *In* NASA. Headquarters, Biomedical Polar Research Workshop Minutes 11 Oct. 1990 6 p (For primary document see N93-16799 05-51)

Avail: CASI HC A02/MF A02

This is a collection of viewgraphs on the Johnson Space Center's work on infectious disease. It addresses their major concern over outbreaks of infectious disease that could jeopardize the health, safety and/or performance of crew members engaged in long duration space missions. The Antarctic environment is seen as an analogous location on Earth and a good place to carry out such infectious disease studies and methods for proposed studies as suggested. J.P.S.

N93-16805*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

NUTRITION

Helen W. Lane *In* NASA. Headquarters, Biomedical Polar Research Workshop Minutes 11 Oct. 1990 4 p (For primary document see N93-16799 05-51)

Avail: CASI HC A01/MF A02

This is a collection of viewgraphs on the Johnson Space Center's work on nutrition for long duration space missions. Nutritional requirements are affected by isolation, workloads, and cold as well as the psychological needs, metabolism, and fluid balance of an individual. J.P.S.

N93-16806*# Colorado Univ., Boulder.

IMMUNOLOGY PRESENTATION AT THE 1990 NASA/NSF ANTARCTICA BIOMEDICAL SCIENCE WORKING GROUP

Richard T. Meehan *In* NASA. Headquarters, Biomedical Polar Research Workshop Minutes 11 Oct. 1990 4 p (For primary document see N93-16799 05-51)

Avail: CASI HC A01/MF A02

An overview of methodology used for determining human in vitro lymphocyte activation, proliferation and effector cell function was presented and results of previous manned space flight immunology studies from Apollo through Shuttle were reviewed. Until the Shuttle era, lymphocyte assays were not very sensitive and had such large variations among normal subjects that it was difficult to define a consistent effect of space flight. More sensitive assay, however, even with Shuttle missions as brief as 6 days indicate depressed T-cell proliferative responses are routinely observed following space flight. Using a slight modification of the Shuttle assay, five different human stress-immunology models have been studied over the last 6 years in our lab. These have included: academic examinations of medical students having blood drawn during major test periods on three separate groups of first year students and two hypoxia studies (at 25,000 feet in a 6 week chamber ascent to the equivalent of Mount Everest and twice on Pikes Peak at 14,000 feet). These studies are particularly pertinent to Antarctica, since the altitude equivalent of 11,000 feet at the South Pole may affect some of the variables that are being measured in immunology, physiology or cognitive studies. An extravehicular study was performed drawing blood from 35 individuals before and immediately following a chamber exposure study. Preliminary results from 30 Shuttle astronauts investigated immunophenotype analysis and the role of a novel monocyte population in modulating the previously observed suppressed in vitro immune function. The results of the Air Force Academy cadet stress study were also presented. Author

N93-16807*# National Aeronautics and Space Administration, Washington, DC.

EXERCISE DURING LONG TERM EXPOSURE TO SPACE: VALUE OF EXERCISE DURING SPACE EXPLORATION

In its Biomedical Polar Research Workshop Minutes 11 Oct. 1990 13 p Prepared in cooperation with National Science Foundation, Washington, DC (For primary document see N93-16799 05-51)

Avail: CASI HC A03/MF A02

There appear to be two general physiological reasons why exercise will be beneficial to space travelers who will experience a weightless and

isolated environment for many months or a few years: (1) to alleviate or prevent tissue atrophy (principally bone and muscle), to maintain cardiovascular function, and to prevent deleterious changes in extracellular and cellular fluid volumes and plasma constituents, especially electrolytes; and (2) to maintain whole organism functional physical and physiological status with special reference to neuromuscular coordination (physical skill) and physical fitness (muscle strength and power, flexibility, and aerobic endurance). The latter reason also relates well to the ability of the crew members to resist both general and local fatigue and thus ensure consistent physical performance. Various forms of exercise, performed regularly, could help alleviate boredom and assist the travelers in coping with stress, anxiety, and depression. The type, frequency, duration and intensity of exercise and ways of ensuring that crew members engage in it are discussed.

J.P.S.

N93-16808*# Anacapa Sciences, Inc., Santa Barbara, CA.

LONG-DURATION ISOLATION AND CONFINEMENT: HUMAN FACTORS ISSUES AND RESEARCH REQUIREMENTS c53

Jack Stuster *In* NASA. Headquarters, Biomedical Polar Research Workshop Minutes 11 Oct. 1990 22 p (For primary document see N93-16799 05-51)

Avail: CASI HC A01/MF A02

Viewgraphs for a presentation on habitability issues and requirements of long-term isolation and confinement are provided. Analogous situations were scored, design implications were listed, and research requirements that could be satisfied by behavioral studies conducted in the Antarctic are itemized, as well as habitat projects already designed. J.P.S.

N93-17049*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

KINETIC TETRAZOLIUM MICROTITER ASSAY Patent Application

Duane L. Pierson, inventor (to NASA), Raymond P. Stowe, inventor (to NASA), and David W. Koeing, inventor (to NASA) 31 Jul. 1992 29 p

(NASA-Case-MSC-21979-1; NAS 1.71:MSC-21979-1; US-Patent-Appl-SN-931942) Avail: CASI HC A03/MF A01

A method for conducting an in vitro cell assay using a tetrazolium indicator is disclosed. The indicator includes a nonionic detergent which solubilizes a tetrazolium reduction product in vitro and has low toxicity for the cells. The incubation of test cells in the presence of zolium bromide and octoxynol (TRITON X-100) permits kinetics of the cell metabolism to be determined. NASA

N93-17189# Argonne National Lab., IL.

PRIMARY CHARGE SEPARATION IN ISOLATED PHOTOSYSTEM 2 REACTION CENTERS

M. Seibert, S. Toon (Midwest Research Inst., Golden, CO.), Govindjee (Illinois Univ., Urbana.), M. P. ONeil, and M. R. Wasielewski 24 Aug. 1992 5 p Presented at the 9th International Congress on Photosynthesis, Nagoya (Japan), 30 Aug. - 5 Sep. 1992

(Contracts W-31-109-eng-38; DE-AC02-83CH-10093)

(DE92-041128; ANL/CP-76567; CONF-9208155-2) Avail: CASI HC A01/MF A01

Primary charge-separation in isolated bacterial reaction center (RC) complex occurs in 2.8 ps at room temperature and 0.7-1.2 ps at 10 K. Because of similarities between the bacterial and photosystem 2 (PS2) RC's, it has been of considerable interest to obtain analogous charge-separation rates in the higher plant system. Our previous femtosecond transient absorption studies used PS2 RC material stabilized with PEG or by exchanging dodecyl maltoside (DM) for Triton in the isolation procedure. These materials gave charge-separation 1/e times of 3.0 +/- 0.6 ps at 4 C and 1.4 +/- 0.2 ps at 15 K based on the risetime of transient absorption kinetics at 820 nm. These values were thought to represent the time required for formation of the P680(+)-Pheo(-) state. Recent results of Hastings et al. obtained at high data acquisition rates and low flash intensities, suggest that the Pheo(sup (-) state may form more slowly. In light of this work, we have carried out additional time domain studies of both electron transport and energy transfer phenomena in stabilized DM PS2 RC's at room temperature. We used a 1-kHz repetition rate femtosecond transient absorption spectrometer with a 200 fs instrumental time resolution and compared the results with those obtained by others using frequency domain hole-burning techniques. DOE

N93-17214# Rome Univ. (Italy). Dipt. di Fisica.

EFFECTIVE NEURONS AND ATTRACTOR NEURAL NETWORKS IN CORTICAL ENVIRONMENT

Daniel J. Amit (Hebrew Univ., Jerusalem, Israel) and M. V. Tsodyks (Hebrew Univ., Jerusalem, Israel) 9 Oct. 1991 18 p Submitted for publication

(Preprint-829; ETN-93-92932) Avail: CASI HC A03/MF A01

Single neuron spike dynamics is discussed. In the case considered, the neural afferent spike input, originating from nonspecific spontaneous activity, is very large compared with the input produced by specific operation of a critical module. The situation prevailing in associative context is analyzed. It is shown that the Frolov-Cowan 'point approximation' can be derived systematically in this case, even in the presence of shunting inhibition. The same type of logic is applied to the cable theory equation for the neuron. Under low ratio of signal to spontaneous activity in the input, the dynamics linearizes, leading to an integrate and fire behavior for the effective neuron. The only remnant of the geometric structure of the dendritic tree, is a weakening of the post synaptic potential due to the spatial decay of the spike influence and a time delay for the arrival of the peak of the spike influence. This description can be reexpressed in terms of rates. The role of the low rates of the selectivity spiking neurons is found to be essential in the argument. ESA

N93-17359# California Univ., Berkeley. Lawrence Berkeley Lab.

MATHEMATICS AND BIOLOGY: THE INTERFACE, CHALLENGES AND OPPORTUNITIES

S. A. Levin, ed. Jun. 1992 96 p Presented at the National Science Foundation Workshop on Mathematics and Biology, Washington, DC, 28 Apr. - 3 May 1990

(Contract DE-AC03-76SF-00098)

(DE92-041207; LBL-PUB-701; CONF-9004365-Summ) Avail: CASI HC A05/MF A01

The interface between mathematics and biology has long been a rich area of research, with mutual benefit to each supporting discipline. Traditional areas of investigation, such as population genetics, ecology, neurobiology, and 3-D reconstructions, have flourished, despite a rather meager environment for the funding of such work. In the past twenty years, the kind and scope of such interactions between mathematicians and biologists have changed dramatically, reaching out to encompass areas of both biology and mathematics that previously had not benefited. At the same time, with the closer integration of theory and experiment, and the increased reliance on high-speed computation, the costs of such research grew, though not the opportunities for funding. The perception became reinforced, both within the research community and at funding agencies, that although these interactions were expanding, they were not doing so at the rate necessary to meet the opportunities and needs. A workshop was held in Washington, DC, between 28 Apr. and 3 May 1990 which drew together a broadly based group of researchers to synthesize conclusions from a group of working papers and extended discussions. The result is the report presented here, which we hope will provide a guide and stimulus to research in mathematical and computational biology for at least the next decade. The report identifies a number of grand challenges, representing a broad consensus among the participants. DOE

N93-17780*# Colorado Univ., Boulder. Aerospace Engineering Sciences.

AUTONOMOUS SUPPORT FOR MICROORGANISM RESEARCH IN SPACE

Mary L. Fleet, Mark S. Miller, Derek Shipley, E., and Jeff D. Smith 1992 107 p

(Contract NASw-4435)

(NASA-CR-192062; NAS 1.26:192062) Avail: CASI HC A06/MF A02

A preliminary design for performing on orbit, autonomous research on microorganisms and cultured cells/tissues is presented. An understanding of gravity and its effects on cells is crucial for space exploration as well as for terrestrial applications. The payload is designed to be compatible with the Commercial Experiment Transporter (COMET) launch vehicle, an orbiter middeck locker interface, and with Space Station Freedom. Uplink/downlink capabilities and sample return through controlled reentry are available for all carriers. Autonomous testing activities are preprogrammed with in-flight reprogrammability. Sensors for monitoring temperature, pH, light, gravity levels, vibrations, and radiation are provided

for environmental regulation and experimental data collection. Additional experimental data acquisition includes optical density measurement, microscopy, video, and film photography. On-board full data storage capabilities are provided. A fluid transfer mechanism is utilized for inoculation, sampling, and nutrient replenishment of experiment cultures. In addition to payload design, representative experiments were developed to ensure scientific objectives remained compatible with hardware capabilities. The project is defined to provide biological data pertinent to extended duration crewed space flight including crew health issues and development of a Controlled Ecological Life Support System (CELSS). In addition, opportunities are opened for investigations leading to commercial applications of space, such as pharmaceutical development, modeling of terrestrial diseases, and material processing. Author

N93-17303*# Alabama Univ., Huntsville. Dept. of Biological Sciences.
GROUND TESTING OF BIOCONVECTIVE VARIABLES SUCH AS MORPHOLOGICAL CHARACTERIZATIONS AND MECHANISMS WHICH REGULATE MACROSCOPIC PATTERNS
Adriel D. Johnson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 3 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17458*# American Inst. of Biological Sciences, Washington, DC.
POSSIBLE BIOMEDICAL APPLICATIONS AND LIMITATIONS OF A VARIABLE-FORCE CENTRIFUGE ON THE LUNAR SURFACE: A RESEARCH TOOL AND AN ENABLING RESOURCE
Keith L. Cowing *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 353-357 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N93-15824# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
OPERATIONAL USE OF CONTACT LENSES BY MILITARY AIRCREW [L'UTILISATION OPERATIONNELLE DES LENTILLES DE CONTACT]
E. Alnaes, ed. Oct. 1992 36 p
(AGARD-AG-334; ISBN-92-835-0690-1) Copyright Avail: CASI HC A03/MF A01

The text discusses the operational requirements of military personnel relative to the use of contact lenses (CL) and particular emphasis is given to the experience of those NATO air forces that currently have aircrew flying with contact lenses. Topics such as lens optical performance, user compliance, and a definition of adequate eye-care supervision are highlighted. The text seeks to identify the critical factors to be taken into account when the decision is made to permit the use of contact lenses by military aircrew, and weights medical considerations and military field conditions, in this regard. Finally, specific military aeromedical conditions in modern aircraft are discussed, with emphasis on the advantages and disadvantages of CL visual correction. Based on extensive deliberations in the group, WG 16 offers a detailed list of recommendations for the use of CL by military aircrews. These recommendations will also be useful for military medical authorities supervising visual correction guidelines for non-flying personnel. Author

N93-15900# Michigan Univ., Ann Arbor.
NEW TECHNIQUES FOR POSITRON EMISSION TOMOGRAPHY IN THE STUDY OF HUMAN NEUROLOGICAL DISORDERS Progress Report, 15 Jun. - 31 Oct. 1992
1992 5 p
(Contract DE-FG02-87ER-60561)
(DE93-002098; DOE/ER-60561/7) Avail: CASI HC A01/MF A01

During the past six months, we have continued work on the fronts of kinetic modeling of radioligands for studying neurotransmitter/receptor systems, iterative reconstruction techniques, and methodology for PET cerebral blood flow activation studies. Initial human PET studies have been performed and analyzed with many different kinetic model formulations to determine the quantitative potential of the neuronwsmitter/receptor ligand, (C-11)N-methyl piperidyl benzilate (NMPB), a muscarinic cholinergic antagonist. In addition, initial human studies using (C-11)tetrabenazine (TBZ), a marker for monoantine nerve terminal density. Results of the NWB studies have indicated that this new agent yields better estimates of receptor density than previous muscarinic ligands developed at our facility, (C-11)-TRB and (C-11)scopolamine. TRB and scopolamine have previously been shown to be only partially successful ligands due to sub-optimal values of the individual rate constants, causing varying degrees of flow limitation. This is found to be much less of a problem for NMPB due to the 2.0 to 2.5 fold increase in ligand transport observed in the human studies (approx. 60 pct. first pass extraction). A 2-parameter 2-compartment simplification had previously been implemented for the benzodiazepine ligand, (C-11)FMZ, and a similar model appears to be suitable for TBZ based on the preliminary human data. DOE

N93-16041# Federal Aviation Administration, Washington, DC. Office of Aviation Medicine.
ENHANCEMENT OF DRUG DETECTION AND IDENTIFICATION BY USE OF VARIOUS DERIVATIZING REAGENTS ON GC-FTIR ANALYSIS Final Report
Edwin F. Huffine and Dennis V. Canfield Jul. 1992 8 p
(AD-A255582; DOT/FAA/AM-92/25) Avail: CASI HC A02/MF A01

Phenylpropanolamine (PPA) is a relatively common non-prescription sympathomimetic amine. As such, it is frequently detected during forensic analysis. The presence of phenylpropanolamine can be confirmed by using Gas Chromatograph-Fourier Transform Infrared (GC-FTIR) spectrophotometry. One constraint of the GC-FTIR is the quantity of material required to obtain a suitable IR spectrum. If a drug is a relatively weak infrared absorber, several micrograms may be required in order to obtain a clear, reliable spectrum. While this amount of material may be readily available for some types of analysis, it can easily exceed the quantity of material available in the forensic toxicology setting. One method that can be used to increase a drug's infrared absorption is to derivatize the drug with a polyfluorinated acid anhydride. Since carbonyl and carbon-fluorine bonds are strong infrared absorbers, molecules that possess such bonds have a heightened sensitivity to GC-FTIR analysis. Polyfluorinated acid anhydrides are capable of adding both carbonyl and carbon-fluorine bonds to drugs that possess either a hydroxyl, primary or secondary amine, or primary or secondary amide functional groups. Several derivatizing reagents were used and the extent to which they enhanced the identification of phenylpropanolamine were compared. Of the reagents studied, heptafluorobutyric acid anhydride (HFAA) produced the greatest increase in the phenylpropanolamine's sensitivity to GC-FTIR identification. Prior to derivatization, 1.8 micrograms of phenylpropanolamine was required for identification on the GC-FTIR, while only 0.032 micrograms of phenylpropanolamine was required after derivatization with HFAA. GRA

N93-16166# Southwest Research Inst., San Antonio, TX. Dept. of Biosciences and Bioengineering.
INVESTIGATION OF EFFECTS OF 60-Hz ELECTRIC AND MAGNETIC FIELDS ON OPERANT AND SOCIAL BEHAVIOR AND ON THE NEUROENDOCRINE SYSTEM OF NONHUMAN PRIMATES: NEUROENDOCRINE PORTION OF EXPERIMENT 4
W. R. Rogers and J. W. Rhodes 31 Aug. 1992 401 p
(Contract DE-AC02-80RA-50219)
(DE92-040955; DOE/RA-50219/T22) Avail: CASI HC A18/MF A04

The neuroendocrine portion of Experiment 4 is reported. Serum melatonin concentration was measured in individual baboons, each implanted with a chronically indwelling venous cannula. As in Experiment 3, the system of six automatic blood samplers was used to achieve undisturbed, 24 hr per day, simultaneous blood sampling from six individual subjects. The objective was to determine if 30 kV/m electric and 1.0 G magnetic field (E/MF) exposure produced a 50 pct decline in nocturnal serum melatonin concentration. Other groups of subjects were tested concurrently during Experiment 4 to assess E/MF effects on group social and individual operant behavior. The results of these experiments will be covered future reports. The results of Experiment 4, as was the case with the result of Experiments 3 and 3A, provide little or no evidence that E/MF exposure, under the conditions of these experiments, affects nocturnal serum melatonin concentrations of nonhuman primates. Together the negative results of

Experiments 3, 2 and 4 indicate that day-time exposure of primates to slow-onset/offset, regularly-scheduled E/MF does not produce melatonin suppression, strongly suggesting that such exposure would not affect human melatonin either. However, before concluding that E/MF exposure in general has no effect on primate melatonin, nightime exposure needs to be examined, and the possibility, suggested by the Pilot Experiment, that fast onset/offset, irregularly-scheduled E/MF can completely suppress melatonin needs to be investigated. DOE

N93-16187# Alaska Univ., Anchorage. Denali Medical Research Proj.
NIFEDIPINE FOR TREATMENT OF HIGH ALTITUDE PULMONARY EDEMA Final Report, 1 May 1991 - 30 Sep. 1992
Peter H. Hackett, R. C. Roach, E. R. Greene, and B. Levine 30 Jul. 1992 29 p
(Contract DAMD17-91-C-1076; DA Proj. 3M1-61102-BS-15)
(AD-A256959) Avail: CASI HC A03/MF A01

In 12 subjects with high altitude pulmonary edema, we studied the effects of 10 mg nifedipine on pulmonary and systemic hemodynamics and arterial oxygen saturation. In five of these, repeated dosing was done over 3 hours and spirometry and clinical HAPE scores were also obtained. A single 10 mg nifedipine dose lowered pulmonary vascular resistance and pulmonary arterial pressures, as well as systemic arterial pressure and increased SaO 2 pct. Multiple dosing sustained the drug effect, but with a smaller increase SaO 2 pct. Clinical scores improved slightly, and within 3 hours there was no consistent effect on spirometry. In addition, we undertook a survey of pulmonary hypertension (PHT) at high altitude, and surprisingly discovered excessive PHT in asymptomatic individuals. We conclude that nifedipine vasodilates the pulmonary bed in persons with HAPE, and that this appears to be beneficial, although short-term improvement was minimal. Since asymptomatic PHT is common, factors other than PHT are critical in HAPE pathogenesis, and by extension, could be important in prevention and treatment. GRA

N93-16441# Michigan Univ., Ann Arbor.
NON-INVASIVE EVALUATION OF THE CARDIAC AUTONOMIC NERVOUS SYSTEM BY PET
1992 10 p
(Contract DE-FG02-90ER-61091)
(DE92-041077; DOE/ER-61091/2) Avail: CASI HC A02/MF A01

The proposed research addresses the development, validation and application of cardiac positron emission tomography (PET) imaging techniques to characterize the autonomic nervous system of the heart. PET technology has significantly matured over the last two decades. Instrument design, image processing and production of radiochemical compounds have formed an integrative approach to provide a powerful and novel imaging modality for the quantitative in vivo evaluation of the autonomic nervous system of the heart. Animal studies using novel tracers for the sympathetic and parasympathetic nerve terminals will be employed to characterize the functional integrity of nerve terminals. This work will be complemented by the development of agents which bind to postsynaptic receptor sites. The combined evaluation of presynaptic and postsynaptic neuronal function will allow a unique characterization of neuronal function. Initial development in animal studies will be followed by feasibility studies in humans. These studies are designed to test sophisticated imaging protocols in the human heart and validate the scintigraphic findings with independent markers of autonomic innervation. Subsequent clinical application in various cardiac diseases is expected to provide new insights into the neuropathophysiology of the heart. DOE

N93-16552# Argonne National Lab., IL.
EFFECTS OF MAGLEV-SPECTRUM MAGNETIC FIELD EXPOSURE ON CEM T-LYMPHOBLASTOID HUMAN CELL GROWTH AND DIFFERENTIATION
K. R. Groh, C. B. Chubb, F. R. Collart, and E. Huberman 1992 9 p Presented at the 1st World Congress for Electricity and Magnetism in Biology and Medicine, Orlando, FL, 14-29 Jun. 1992
(Contract W-31-109-eng-38)
(DE92-041134; ANL/CP-77257; CONF-920630-2) Avail: CASI HC A02/MF A01

Exposure to magnetic fields similar to those produced by maglev vehicles (combined ac and dc components) was studied for the ability to alter cell growth and chemically induced cellular differentiation processes in cultured human CEM T-lymphoblastoid leukemia cells. A series of continuous and intermittent magnetic field (MF) exposures for varying lengths of time were tested at intensities up to 7-fold greater than that produced by the German TR07 maglev vehicle. Phorbol 12-myristate 13-acetate or mycophenolic acid were used to induce cell differentiation. Changes in cell number, morphology, and fluorescence expression of antigenic markers of differentiation were monitored. The results indicated that maglev-spectrum magnetic field exposures up to 2 gauss had little effect on culture growth or chemically induced cellular differentiation when exposed to maglev-spectrum magnetic fields compared to chemically treated but MF-unexposed controls. DOE

N93-16619*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A COMPARISON OF HAND GRASP BREAKAWAY STRENGTHS AND BARE-HANDED GRIP STRENGTHS OF THE ASTRONAUTS, SML 3 TEST SUBJECTS, AND THE SUBJECTS FROM THE GENERAL POPULATION
Sudhakar L. Rajulu (Lockheed Engineering and Sciences Co., Houston, TX.) and Glenn K. Klute Jan. 1993 17 p
(Contract NAS9-17900)
(NASA-TP-3286; S-690; NAS 1.60:3286) Avail: CASI HC A03/MF A01

Astronauts have the task of retrieving and deploying satellites and handling massive objects in a around the payload bay. Concerns were raised that manual handling of such massive objects might induce loads to the shuttle suits exceeding the design-certified loads. The Crew and Thermal Division of NASA JSC simulated the satellite handling tasks (Satellite Manload Tests 1 and 3) and determined the maximum possible load that a suited member could impart onto the suit. In addition, the tests revealed that the load to the suit by an astronaut could be calculated from the astronaut's maximum hand grasp breakaway strength. Thus, this study was conducted to document that hand grasp breakaway strengths of the astronauts who were scheduled to perform EVA during the upcoming missions. In addition, this study verified whether the SML 3 test results were sufficient for documenting the maximum possible load. An attempt was made to predict grasp strength from grip strength and hand anthropometry. Based on the results from this study, the SML 3 test results were deemed sufficient to document the maximum possible load on the suit. Finally, prediction of grasp strength from grip strength was not as accurate as expected. Hence, it was recommended that grasp strength be collected from the astronauts in order to obtain accurate load estimation. Author

N93-16962# Rome Univ. (Italy). Dipt. di Fisica.
CONVERSION OF TEMPORAL CORRELATIONS BETWEEN STIMULI TO SPATIAL CORRELATIONS BETWEEN ATTRACTORS
M. Griniasty (Hebrew Univ., Jerusalem, Israel), M. V. Tsodyks (Hebrew Univ., Jerusalem, Israel), and Daniel J. Amit (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 17 Jan. 1992 15 p Sponsored by Ministry of Science and Technology
(Preprint-856; ETN-93-92958) Avail: CASI HC A03/MF A01

A simple modification of synaptic structures, constructed to produce autoassociative attractors, is shown to produce neural networks whose attractors are correlated with several patterns used in the construction of the matrix. The modification stores in the matrix a fixed sequence of uncorrelated patterns. The network has correlated attractors, provoked by the uncorrelated stimuli. The network converts the temporal order into spatial correlations expressed in the distributions of neural activities in attractors. The model captures phenomena observed in single electrode recordings in performing monkeys. The correspondence is close enough to reproduce the fact that, given uncorrelated patterns as sequentially learned stimuli, the attractors produced are signifiantly correlated up to a separation of five in the sequence. This number is universal in a range of parameters, and requires no tuning. Learning scenarios, which could lead to this synaptic structure as well as experimental predictions following from it, are studied. The cognitive utility of such arrangement is considered. ESA

N93-17058*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
BRIGHT LIGHT DELIVERY SYSTEM Patent Application
Benita C. Hayes, inventor (to NASA) 4 Dec. 1992 14 p

(NASA-Case-MFS-28723-1; NAS 1.71:MFS-28723-1;
US-Patent-Appl-SN-986631) Avail: CASI HC A03/MF A01

A bright light therapy delivery system is disclosed. The system enhances the efficient delivery of bright light therapy by directing the light to the user's eyes while permitting the user to engage in other sedentary activities, such as reading. A shroud is disclosed which has reflective non-specular interior surfaces and which enclosed a bright light source of known kind. The shroud can be configured for delivery of bright light therapy in a direct, indirect, or direct/indirect mode. In the direct mode, the bright light source is located at the back of the shroud and faces the user; in the indirect mode, the bright light source is located within the shroud and faces away from the user; in the direct/indirect mode, the bright light source is located within the shroud, and has two luminous appertures, one facing the user and the other facing opposite the user. NASA

N93-17230# Sandia National Labs., Albuquerque, NM.
APPLICATION OF RADTRAN TO ESTIMATION OF DOSES TO PERSONS IN ENCLOSED SPACES
K. S. Neuhauser 1992 4 p Presented at the 10th International Symposium on the Packaging and Transportation of Radioactive Materials, Yokohama, Japan, 13-18 Sep. 1992
(Contract DE-AC04-76DP-00789)
(DE93-000758; SAND-91-2603C; TTC-1121; CONF-920905-32) Avail: CASI HC A01/MF A01

The RADTRAN computer code for transportation risk analysis can be used to estimate doses to persons in enclosed volumes. This application was developed in response to a need to examine consequences of a hypothetical container leak during accident-free transportation by cargo air. The original problem addressed tritium containers, but the method can be applied to any gaseous or suspended particulate material potentially released in an airplane or other enclosed area (e.g., warehouse) under accident-free conditions. Such leakage can occur during shipment of any radioactive gas or material with a gaseous phase. Atmospheric dispersion is normally modeled in RADTRAN as a series of downwind isopleths each of which is assigned a dilution factor (also known as time-integrated concentration or X/Q value). These values are located in look-up tables in RADTRAN and are normally taken from externally performed Gaussian dispersion calculations. The dilution factors are used to estimate inhalation dose to persons in the specified downwind areas. DOE

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N93-16111# Maryland Univ., Baltimore. School of Medicine.
DEVELOPMENT AND ENHANCEMENT OF A MODEL OF PERFORMANCE AND DECISION MAKING UNDER STRESS IN A REAL LIFE SETTING Final Quarterly Report, 31 Jan. - 1 May 1992
Colin F. Mackenzie 8 May 1992 22 p
(Contract N00014-91-J-1540)
(AD-A255699) Avail: CASI HC A03/MF A01

A system for acquiring data from which to model human performance under stress is described. An anesthesiologist and a nurse anesthetist at work on trauma cases are recorded, video taped, and evaluated in a post-trauma questionnaire. Four locations in two operating rooms and two admitting areas are cabled with a camera, a microphone, a computer, interfaces to physiological monitors, and a network interface. The system is fully automated, but tapes may need to be replaced after 2 hours. The methods for analyzing data are also discussed. J.P.S.

N93-16189# Advanced Aviation Concepts, Jupiter, FL.
WORKSHOP ON AERONAUTICAL DECISION MAKING (ADM). VOLUME 1: EXECUTIVE SUMMARY Final Report
Ronald J. Lofaro Aug. 1992 76 p Workshop held in Denver, CO, 6-7 May 1992
(Contract DTFA01-90-C-00042)
(AD-A257016; DOT/FAA/RD-91/14-Vol-1) Avail: CASI HC A05/MF A01

This report presents Aeronautical Decision Making (ADM) training accomplishments, limitations, and future needs from the perspectives of commercial operators, general aviation, military aviation, and research development. A select group of experts on ADM was convened to share ideas, identify and explore future directions for advanced training. Cognitive training requirements based upon decision making task demands of both airplane and helicopter pilots and crews are analyzed. A major question which requires definitional research is the following: What is a real aircrew/pilot decision? That is, when does an event generate a true decisional opportunity for a pilot or crew versus a one-path only reaction, where the actual emphasis is not on cognitive decision making, but the application of procedures and basic airmanship. Going one step further, the group analyzed the decision making differences between expert and novice pilots when a real decision was required. GRA

N93-17026# Rome Univ. (Italy). Dipt. di Fisica.
CONSTRAINTS ON LEARNING IN DYNAMIC SYNAPSES
Daniel J. Amit (Istituto Nazionale di Fisica Nucleare, Rome, Italy) and Stafano Fusi (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 2 Jun. 1992 24 p
(Preprint-890; ETN-93-92990) Avail: CASI HC A03/MF A01

Hebbian type learning is discussed. A network whose synapses are analog, dynamic variables, whose values have to be periodically refreshed due to possible exponential decay, or other instability of continuous synaptic efficacies, is considered. It is shown that the end product of learning in such networks is very sensitive to the relation between the rate of presentation of patterns and the size of the refresh time interval. It is shown that in the limit of slow presentation, the network can learn at most O(ln N) patterns in N neurons, and must learn each one in one shot, thus learning all errors present in a corrupt stimulus presented for retrieval. The analysis shows that as the rate of presentation is increased, the performance is increased rapidly. The refresh mechanism acting stochastically is investigated. The network and the three learning models are defined. It is shown that the capacity of the network can be expressed in terms of a single parameter: the fraction of the synapses which retain a dependence on every pattern in the sequence of learned patterns. The storage capacities for all learning scenarios are analyzed. The expressions for the relevant fractions are derived. The results are supported by simulations. ESA

N93-17684# Dayton Univ., OH.
AUTOMATIC INFORMATION PROCESSING AND HIGH PERFORMANCE SKILLS: INDIVIDUAL DIFFERENCES AND MECHANISMS OF PERFORMANCE IMPROVEMENT IN SEARCH-DETECTION AND COMPLEX TASKS Interim Technical Report, Nov. 1990 - Dec. 1991
Arthur D. Fisk, Kevin A. Hodge, Wendy A. Rogers, Mark D. Lee, and Christopher K. Hertzog Sep. 1992 384 p Prepared in cooperation with Georgia Inst. of Tech., Atlanta, GA
(Contract F33615-88-C-0015)
(AD-A257711; AL-TP-1992-0048) Avail: CASI HC A17/MF A03

This document summarizes Phase 3 of the basic research effort investigating automatic processing theory and high-performance skills training. Research issues such as skill acquisition, skill retention, and part-task training are explored. The studies were conducted to examine: individual differences in performance improvement in memory, visual, and hybrid memory/visual search; effects of varying degrees of inconsistency on skilled visual search; development of optimal search strategies; and part-task training effects in learning and retaining complex task performance. The results of this work suggest further investigation of the principles for the application of automatic processing theory to training complex skills. GRA

N93-16783*# Ohio State Univ., Columbus. Dept. of Psychology.
COGNITIVE AND AFFECTIVE COMPONENTS OF MENTAL WORKLOAD: UNDERSTANDING THE EFFECTS OF EACH ON HUMAN DECISION MAKING BEHAVIOR
Thomas E. Nygren *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 154-156 (For primary document see N93-16760 05-80) Avail: CASI HC A01/MF A03

N93-16801*# National Aeronautics and Space Administration, Washington, DC.
SUMMARY OF PRESENTATION FOR RESEARCH ON SOCIAL STRUCTURE, AGREEMENT, AND CONFLICT IN GROUPS IN EXTREME AND ISOLATED ENVIRONMENTS
In its Biomedical Polar Research Workshop Minutes 11 Oct. 1990 1 p (For primary document see N93-16799 05-51)
Avail: CASI HC A01/MF A02

N93-16808*# Anacapa Sciences, Inc., Santa Barbara, CA.
LONG-DURATION ISOLATION AND CONFINEMENT: HUMAN FACTORS ISSUES AND RESEARCH REQUIREMENTS
Jack Stuster *In* NASA. Headquarters, Biomedical Polar Research Workshop Minutes 11 Oct. 1990 22 p (For primary document see N93-16799 05-51)
Avail: CASI HC A01/MF A02

N93-17310*# Alabama Univ., Huntsville. Dept. of Industrial Engineering.
DEVELOPMENT OF A PROTOTYPE INTERACTIVE LEARNING SYSTEM USING MULTI-MEDIA TECHNOLOGY FOR MISSION INDEPENDENT TRAINING PROGRAM
Jack E. Matson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 6 p (For primary document see N93-17279 05-80)
Avail: CASI HC A02/MF A03

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N93-15710# Aerospace Medical Research Labs., Brooks AFB, TX.
NIGHT VISION MANUAL FOR THE FLIGHT SURGEON
Robert E. Miller, II and Thomas J. Tredici Aug. 1992 122 p Revised
(AD-A257059; AL-SR-1992-0002) Avail: CASI HC A06/MF A02

This manual is updated and extensively revised successor to the 1985 edition. It is a definitive reference that provides current guidance for flight surgeons who can use it as a source document in providing night vision briefings, conducting NVG training sessions, discussing aeromedical limitations, and applying appropriate medical standards. It can also be used by flight surgeons in conjunction with night vision demonstration kits and other teaching aids. Author

N93-15968# Battelle Columbus Labs., OH.
HUMAN FACTORS DESIGN PRINCIPLES FOR INSTRUMENT APPROACH PROCEDURE CHARTS. VOLUME 1: READABILITY Final Report
Susan J. Mangold, Donald Eldredge, and Erick Lauber Aug. 1992 185 p Sponsored by FAA
(AD-A257234; DOTVNTSC-FAA-92-9-Vol-1;
DOT/FAA/RD,XH-92/16.1-Vol-1) Avail: CASI HC A09/MF A02

This Handbook is the first of a series of handbooks which address the issue of Instrument Approach Procedure (IAP) chart improvement in design. The intent is twofold: to review relevant literature that might be applicable to improving the presentation of chart information to support effective and efficient access to information by the user and to develop guidance information based upon this research, that can be easily accessed and implemented by the chart designer. The handbook is intended to offer the chart designer guidance information that can aid in developing charts which clearly present a meaningful visual structure. GRA

N93-16033# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
MEASUREMENT AND EVALUATION OF BLAST OVERPRESSURE DURING F-15A CREW STATION VULNERABILITY ASSESSMENT TEST Final Report, Mar. - Dec. 1991
Harald K. Hille Dec. 1991 71 p
(AF Proj. 7231)
(AD-A257152; AL-TR-1992-0033) Avail: CASI HC A04/MF A01

From March 1991 to May 1991 blast overpressures were measured from 21 different projectiles striking a section of the F-15 fuselage to assess potential crew hazards. The velocity of the fired projectiles ranged from 1500 to 5000 ft/sec and the lowest overpressure which was recorded was 7 PSF or 145 dB and the highest level recorded was 1875 PSF or 194 dB sound pressure level (re 20 u Pa). Time histories for each recording and the sound exposure spectrum levels as a function of frequency are presented. A hearing damage risk assessment was made in the context of the Air Force hearing damage risk criteria (AFR 161-35) and laboratory data regarding the effects of high level impulses on man. GRA

N93-16048# Human Engineering Labs., Aberdeen Proving Ground, MD.
GLOVED OPERATOR PERFORMANCE STUDY Final Report
Jan Berkhout, Glen Anderson, Michelle McCleerey, and Michael Granaas Sep. 1992 141 p
(DA Proj. 1L1-62716-AH-70)
(AD-A256894; HEL-TM-7-92) Avail: CASI HC A07/MF A02

This study is to determine whether greater minimum spacing is required between push buttons for gloved operation than for bare-handed operation. Seventy-two undergraduate students served as subjects in groups of 12, one group for each of the six hand-wear conditions. The six hand-wear conditions consisted of one bare-handed group and five glove groups. Each of these five groups were one of the following glove types: a butyl and cotton glove assembly, a butyl and nomex glove assembly, a leather and wool glove assembly, a fire-fighting glove, or a thin vinyl glove. Subjects performed two button-pushing tasks. One task was self paced, allowing subjects to determine response times. The other task was machine paced, allowing subjects decreasing amounts of time to respond. Subjects performed these tasks on three different panels containing nine buttons each. The three panels varied by spacing between the buttons. One panel contained buttons 13 mm apart, another 19 mm apart, and another 25 mm apart. Results from the self-paced task indicate that subjects responded faster on the 13-mm and 19-mm panels than on the 25-mm panel. This suggests that the 13-mm spacing is adequate for speed of operation for gloved operators. Error data and machine-paced time data neither support nor contradict this result. Results also indicate that subjects with larger hands tend to score faster times with more errors in the machine-paced task. This effect does not seem to be because of gender differences. GRA

N93-16258# Defense Technical Information Center, San Diego, CA. MATRIS Office.
DIRECTORY OF DESIGN SUPPORT METHODS
Sep. 1992 162 p
(AD-A256987) Avail: CASI HC A08/MF A02

This Directory of Design Support Methods is the product of the Designing for the User Subgroup of the Department of Defense Human Factors Engineering Technical Group. An annotated directory is provided of human factors design support tools and techniques that have been developed by the DoD, NASA, and industry members of the technical group. The Directory contains human factors databases, handbooks, data guides, texts, journals, military standards, prototype and interface design tools, analytic techniques, and computer simulation software. The Directory describes the methods to be used and their purpose, products, and availability. It serves as a resource in applying human factors for anyone who is designing a system or evaluating the design of one. The format for each entry offers the name of the method, the sponsor, a point of contact, and a full description including general overview, appropriate uses, input requirements, processing procedures, output products, and uses. GRA

N93-16699*# Massachusetts Univ., Amherst. Dept. of Exercise Science and Industrial Engineering and Operations Research.
ADAPTATION TO TRANSIENT POSTURAL PERTURBATIONS Final Report
Robert O. Andres Oct. 1992 55 p Prepared in cooperation with Ergonomic Engineering Associates, Pelham, MA
(Grant NAG9-291)
(NASA-CR-190959; NAS 1.26:190959) Avail: CASI HC A04/MF A01

This research was first proposed in May, 1986, to focus on some of the problems encountered in the analysis of postural responses gathered from crewmembers. The ultimate driving force behind this line of research

was the desire to treat, predict, or explain 'Space Adaptation Syndrome' (SAS) and hence circumvent any adverse effects of space motion sickness on crewmember performance. The aim of this project was to develop an easily implemented analysis of the transient responses to platform translation that can be elicited with a protocol designed to force sensorimotor reorganization, utilizing statistically reliable criterion measures. This report will present: (1) a summary of the activity that took place in each of the three funded years of the project; (2) discussion of experimental results and their implications for future research; and (3) a list of presentations and publications resulting from this project. Author

N93-16840*# Tuskegee Inst., AL. Center for Food Production, Processing and Waste Management in CELSS.

ANNUAL REPORT

Dec. 1992 151 p Original contains color illustrations

(Grant NAGw-2940)

(NASA-CR-191389; NAS 1.26:191389) Avail: CASI HC A08/MF A02; 23 functional color pages

The overall goal of the Tuskegee University Center for Food Production, Processing and Waste Management in Controlled Ecological Life Support Systems (CELSS) is to provide tested information and technologies applicable to bioregenerative food production systems for life support on long-term manned space mission. Specifically, the center is developing information, computer simulated models, methodologies and technology for sweetpotato and peanut biomass production and processing, inclusive of waste management and recycling of these crops selected by NASA for CELSS. The Center is organized into interdisciplinary teams of life scientists and engineers that work together on specific objectives and long-term goals. Integral to the goal of the Center is the development of both basic and applied research information and the training of young scientists and engineers, especially underrepresented minorities that will increase the professional pool in these disciplines and contribute to the advancement of space sciences and exploration. Author

N93-17042*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

WHEELS FOR WHEELCHAIRS AND THE LIKE Patent Application

Bruce Weddendorf, inventor (to NASA) and Jeffrey Finckenor, inventor (to NASA) 2 Nov. 1992 16 p

(NASA-Case-MFS-28632-1; NAS 1.71:MFS-28632-1;

US-Patent-Appl-SN-970204) Avail: CASI HC A03/MF A01

A wheel is provided herein for vehicles using spoked wheels. Small obstacles, steps, and curbs present serious impediments to wheelchair and bicycle travelers. Yet until recently wheels for these vehicles have remained unchanged. These rigid type vehicles have the disadvantage of transmitting to their users shocks and vibrations generated by traversing over obstacles or rough terrain, creating an uncomfortable ride. The wheel herein responds to loads or shocks while overcoming the difficulties of prior art wheels. The wheel is of the type having a circular rim with the hub at its center, and spokes connected between the hub and the rim. A wheel is provided in which not only the spokes are unique, but the rim as well. NASA

N93-17045*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

PORTABLE SEAT LIFT Patent Application

Bruce Weddendorf, inventor (to NASA) 2 Nov. 1992 12 p

(NASA-Case-MFS-28610-1; NAS 1.71:MFS-28610-1;

US-Patent-Appl-SN-970203) Avail: CASI HC A03/MF A01

A portable seat lift that can help individuals either (1) lower themselves to a sitting position or (2) raise themselves to a standing position is presented. The portable seat lift consists of a seat mounted on a base with two levers, which are powered by a drive unit. NASA

N93-17087*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

CONTROL SYSTEM AND METHOD FOR PROSTHETIC DEVICES Patent Application

Richard J. Bozeman, Jr., inventor (to NASA) 31 Aug. 1992 23 p

(NASA-Case-MSC-21941-1; NAS 1.71:MSC-21941-1;

US-Patent-Appl-SN-937325) Avail: CASI HC A03/MF A01

A control system and method for prosthetic devices is provided. The control system comprises a transducer for receiving movement from a body part for generating a sensing signal associated with that movement. The sensing signal is processed by a linearizer for linearizing the sensing signal to be a linear function of the magnitude of the distance moved by the body part. The linearized sensing signal is normalized to be a function of the entire range of body part movement from the no-shrug position of the movable body part through the full-shrug position of the movable body part. The normalized signal is divided into a plurality of discrete command signals. The discrete command signals are used by typical converter devices which are in operational association with the prosthetic device. The converter device uses the discrete command signals for driving the movable portions of the prosthetic device and its sub-prosthesis. The method for controlling a prosthetic device associated with the present invention comprises the steps of receiving the movement from the body part, generating a sensing signal in association with the movement of the body part, linearizing the sensing signal to be a linear function of the magnitude of the distance moved by the body part, normalizing the linear signal to be a function of the entire range of the body part movement, dividing the normalized signal into a plurality of discrete command signals, and implementing the plurality of discrete command signals for driving the respective movable prosthesis device and its sub-prosthesis. NASA

N93-17088*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

PROTECTIVE HELMET ASSEMBLY Patent Application

Frederic S. Dawn, inventor (to NASA), Fred R. Weiss, inventor (to NASA), and John D. Eck, inventor (to NASA) 4 Nov. 1992 12 p

(NASA-Case-MSC-21842-1; NAS 1.71:MSC-21842-1;

US-Patent-Appl-SN-971116) Avail: CASI HC A03/MF A01

The invention is a protective helmet assembly with improved safety and impact resistance, high resistance to ignition and combustion, and reduced offgassing. The assembly comprises a hard rigid ballistic outer shell with one or more impact absorbing pads fitted to the interior surface. The pads are made of open cell flexible polyimide foam material, each of which is attached to the inner surface of the ballistic outer shell by cooperative VELCRO fastener strips of hook-and-loop material affixed respectively to the rigid outer shell and the impact absorbing pads. The helmet assembly with shell and pads is sized to fit relatively close over a wearer's head. NASA

N93-17697# Analysis and Technology, Inc., New London, CT.

EVALUATION OF NIGHT VISION GOGGLES (NVG) FOR MARITIME SEARCH AND RESCUE Final Summary Report, Mar. 1989 - Jun. 1991

R. Q. Robe, D. L. Raunig, J. V. Plourde, and R. L. Marsee Feb. 1992 17 p

(Contract DTCG39-89-C-E10G56)

(AD-A257704; RDC-11/92; USCG-D-16-92) Avail: CASI HC A03/MF A01

Three experiments were conducted in 1989, three in 1990, and one experiment was conducted in 1991 by the U.S. Coast Guard Research and Development (R and D) Center to evaluate night vision goggles (NVG's) for their effectiveness in detecting small targets at night. Three types of NVG's have been evaluated: the AN/AVS-6 Aviator's Night Vision Imaging System (ANVIS) was evaluated onboard U.S. Coast Guard HH-3F, CH-3E, and HH-60J helicopters, and HU-25C and RG-8A fixed-wing aircraft. The AN/PVS-5C and AN/PVS-7A NVG's were evaluated onboard U.S. and Canadian Coast Guard Search and Rescue Units (SRU's) in the 200-foot size range and onboard U.S. Coast Guard 41-foot utility boats (UTB's). During the Spring 1991 experiment, 4- and 6-person unlighted life rafts with retroreflective tape and 18- and 21-foot white boats were employed as targets during realistically-simulated search missions. Three new SRU's were evaluated and newly obtained information is discussed. A total of 4098 target detection opportunities were generated for all the target types employed during the six experiments. These data were analyzed to determine which of 25 search parameters of interest exerted a statistically-significant influence on target detection probability. Lateral range curves and sweep width estimates are presented for SRU/target type combinations that contained sufficient data to support this detailed analysis. Human factors data are presented and discussed. NVG's proved to be an effective nighttime search aid for helicopter searches for small SAR targets. The results for NVG use for SAR on CG Utility Boats indicated that NVG's did not

significantly enhance search performance, and their routine use is not recommended. GRA

N93-17710*# Texas Univ., Austin. Mechanical Engineering Design Project Program.

DESIGN OF A RADIATOR SHADE FOR TESTING IN A SIMULATED LUNAR ENVIRONMENT

Jaimi Huff, Randy Remington, and Toan Tang 1992 159 p
(Contract NASw-4435)
(NASA-CR-192080; NAS 1.26:192080) Avail: CASI HC A08/MF A02

The National Aeronautics and Space Administration (NASA) and The Universities Space Research Association (USRA) have chosen the parabolic/catenary concept from their sponsored Fall 1991 lunar radiation shade project for further testing and development. NASA asked the design team to build a shading device and support structure for testing in a vacuum chamber. Besides the support structure for the catenary shading device, the design team was asked to develop a system for varying the shade shape so that the device can be tested at different focal lengths. The design team developed concept variants and combined the concept variants to form overall designs. Using a decision matrix, an overall design was selected by the team from several overall design alternatives. Concept variants were developed for three primary functions. The three functions were structural support, shape adjustments, and end shielding. The shade adjustment function was divided into two sub-functions, arc length adjustment, and width adjustment. Author

N93-17805*# Texas Univ., Austin. Mechanical Engineering Design Projects Program.

DESIGN OF A RESISTIVE EXERCISE DEVICE FOR USE ON THE SPACE SHUTTLE Final Report

Dennis L. Carlson, Mohammed Durrani, and Christi L. Redilla 1992 184 p
(Contract NASw-4435)
(NASA-CR-192079; NAS 1.26:192079) Avail: CASI HC A09/MF A02

The National Aeronautics and Space Administration in conjunction with the Universities Space Research Association sponsored the design of a Resistive Exercise Device (RED) for use on the Space Shuttle. The device must enable the astronauts to perform a number of exercises to prevent skeletal muscle atrophy and neuromuscular deconditioning in microgravity environments. The RED must fit the requirements for limited volume and weight and must provide a means of restraint during exercise. The design team divided the functions of the device into three major groups: methods of supplying force, methods of adjusting force, and methods of transmitting the force to the user. After analyzing the three main functions of the RED and developing alternatives for each, the design team used a comparative decision process to choose the most feasible components for the overall design. The design team selected the constant force spring alternative for further embodiment. The device consists of an array of different sized constant force springs which can be pinned in different combinations to produce the required output forces. The force is transmitted by means of a shaft and gear system. The final report is divided into four sections. An introduction section discusses the sponsor background, problem background and requirements of the device. The second section covers the alternative designs for each of the main functions. The design solution and pertinent calculations comprises the third section. The final section contains design conclusions and recommendations including topics of future work. Author

N93-17806*# Texas Univ., Austin. Dept. of Mechanical Engineering.

CONCEPTUAL DESIGN OF A FLEET OF AUTONOMOUS REGOLITH THROWING DEVICES FOR RADIATION SHIELDING OF LUNAR HABITATS Final Report

Karem Armstrong, Daniel A. McAdams, and Jeffery L. Norrell 1992 245 p
(Contract NASw-4435)
(NASA-CR-192078; NAS 1.26:192078) Avail: CASI HC A11/MF A03

The National Aeronautics and Space Administration (NASA) in conjunction with Universities Space Research Association (USRA) has requested that the feasibility of a fleet of regolith tossing devices designed to cover a lunar habitat for radiation protection be demonstrated. The regolith, or lunar soil, protects the lunar habitat and its inhabitants from radiation. Ideally, the device will operate autonomously in the lunar environment. To prove the feasibility of throwing regolith on the Moon, throwing solutions were compared to traditional, Earth-based methods for moving soil. Various throwing configurations were investigated. A linear throwing motion combined with a spring and motor energizing system proved a superior solution. Three different overall configurations for the lunar device are presented. A single configuration is chosen and critical parameters such as operating procedure, system volume, mass, and power are developed. The report is divided into seven main sections. First, the Introduction section gives background information, defines the project requirements and the design criteria, and presents the methodology used for the completion of this design. Next, the Preliminary Analysis section presents background information on characteristics of lunar habitats and the lunar environment. Then, the Alternate Designs section presents alternate solutions to each of the critical functions of the device. Fourth, a detailed analysis of throwing the regolith is done to demonstrate its feasibility. Then, the three overall design configurations are presented. Next, a configuration is selected and the conceptual design is expanded to include system performance characteristics, size, and mass. Finally, the Conclusions and Recommendations for Future Work section evaluates the design, outlines the next step to be taken in the design process, and suggests possible goals for future design work. Author

N93-16862*# Hawaii Univ., Honolulu.

SPACE MIGRATIONS: ANTHROPOLOGY AND THE HUMANIZATION OF SPACE

Ben R. Finney *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 164-188 Repr. from Acta Astronautica, v. 15, 1987 p 189-194 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

N93-16865*# California Univ., Los Angeles.

APPLICATIONS OF LIVING SYSTEMS THEORY TO LIFE IN SPACE

James Grier Miller *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 231-259 Presented at the NASA-NSF Conference on the Human Experience in Antarctica: Applications to Life in Space, Sunnyvale, CA, 17 Aug. 1987 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

N93-16866*# State Univ. of North Texas, Denton.

LIFE SUPPORT AND SELF-SUFFICIENCY IN SPACE COMMUNITIES

Karl R. Johansson *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 260-271 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

N93-16867*# Washington Univ., Saint Louis, MO.

HUMAN SAFETY IN THE LUNAR ENVIRONMENT

Robert H. Lewis *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 272-294 Original contains color illustrations (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

N93-17442*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

INFLATABLE HABITATION FOR THE LUNAR BASE

M. Roberts *In its* The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 249-253 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

N93-17443*# Reynolds (K. H.), McLean, VA.

PRELIMINARY DESIGN STUDY OF LUNAR HOUSING CONFIGURATIONS

K. H. Reynolds *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 255-259 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

N93-17444*# Architectural Horizon, Makkah (Saudi Arabia).

PREFABRICATED FOLDABLE LUNAR BASE MODULAR SYSTEMS FOR HABITATS, OFFICES, AND LABORATORIES

Yousef Hijazi *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 261-266 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

N93-17445*# Construction Technology Labs., Skokie, IL.
CONCRETE LUNAR BASE INVESTIGATION
T. D. Lin, Jonathan A. Senseny (Citadel Coll., Charleston, SC.), Larry D. Arp (Citadel Coll., Charleston, SC.), and Charles Lindbergh (Citadel Coll., Charleston, SC.) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 267-274 Previously announced in IAA as A89-34371 Sponsored by NASA. Johnson Space Center, Prestressed Concrete Inst., Chicago Univ., and Lockheed EMSCO (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

N93-17446*# Future Systems Consultants, Los Angeles, CA.
VERTICAL REGOLITH SHIELD WALL CONSTRUCTION FOR LUNAR BASE APPLICATIONS
Jan Kaplicky, David Nixon, and Jane Wernick (Arup, Ove and Partners, Los Angeles, CA) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 275-279 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

N93-17447*# Integrated Space Systems Corp., Collegeville, PA.
EVOLVING CONCEPTS OF LUNAR ARCHITECTURE: THE POTENTIAL OF SUBSELENE DEVELOPMENT
Andrew W. Daga, Meryl A. Daga, and Wendel R. Wendel (Starnet Structures, Inc., West Babylon, NY.) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 281-291 (For primary document see N93-17414 05-91)
Avail: CASI HC A03/MF A03

N93-17448*# Design Science, Los Angeles, CA.
LUNAR SUBSURFACE ARCHITECTURE ENHANCED BY ARTIFICIAL BIOSPHERE CONCEPTS
Jason D. Klassi, Carlos J. Rocha, and Charles A. Carr *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 293-298 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N93-15825*# Harvard Univ., Cambridge, MA.
WIDE-BANDWIDTH HIGH-RESOLUTION SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE Semiannual Status Report, 15 Jun. - 15 Dec. 1992
Paul Horowitz 15 Jun. 1992 29 p
(Grant NAGw-2872)
(NASA-CR-191618; NAS 1.26:191618) Avail: CASI HC A03/MF A01

Research accomplished in the following areas is discussed: the antenna configuration; HEMT low-noise amplifiers; the downconverter; the Fast Fourier Transform Array; the backend array; and the backend and workstation. Author

N93-16709*# Harvard Univ., Cambridge, MA.
WIDE-BANDWIDTH HIGH-RESOLUTION SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE Semiannual Status Report, 15 Dec. 1991 - 15 Jun. 1992
Paul Horowitz 15 Jun. 1992 20 p
(Grant NAGw-2872)
(NASA-CR-191807; NAS 1.26:191807) Avail: CASI HC A03/MF A01

This interim report summarizes the research accomplished during the initial 6-month period of the grant. Activities associated with antenna configurations, the channelizing downconverter, the fast Fourier transform array, the DSP (digital signal processing) array, and the backend and UNIX workstation are discussed. Publications submitted during the reporting period are listed. Author

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N93-16554*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
SCALABLE PROBLEMS AND MEMORY BOUNDED SPEEDUP Final Report
Xian-He Sun and Lionel M. Ni Washington Nov. 1992 24 p Submitted for publication
(Contract NAS1-19480; NSF ECS-88-14207; RTOP 505-90-52-01)
(NASA-CR-189726; ICASE-92-59; NAS 1.26:189726) Avail: CASI HC A03/MF A01

In this paper three models of parallel speedup are studied. They are fixed-size speedup, fixed-time speedup and memory-bounded speedup. The latter two consider the relationship between speedup and problem scalability. Two sets of speedup formulations are derived for these three models. One set considers uneven workload allocation and communication overhead and gives more accurate estimation. Another set considers a simplified case and provides a clear picture on the impact of the sequential portion of an application on the possible performance gain from parallel processing. The simplified fixed-size speedup is Amdahl's law. The simplified fixed-time speedup is Gustafson's scaled speedup. The simplified memory-bounded speedup contains both Amdahl's law and Gustafson's scaled speedup as special cases. This study leads to a better understanding of parallel processing. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N93-15707# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
REPORT ON WORKSHOP ON RESEARCH IN EXPERIMENTAL COMPUTER SCIENCE
Barbara Liskov Jun. 1992 49 p Workshop held in Palo Alto, CA, 16-18 Oct. 1992
(AD-A256874; MIT/LCS/TR-540) Avail: CASI HC A03/MF A01

This report describes a workshop that was concerned with how to improve research in experimental computer science. The overall goal of the workshop was to identity problems and issues in experimental computer science and to propose solutions. The workshop was sponsored by the Office of Naval Research, in coordination with the NSF, DARPA, and other science agencies that participate in the Federal Coordinating Council on Science Engineering and Technology (FCCSET). It was held on October 16-18, 1991, in Palo Alto, CA. The workshop consisted of two parts. For the first day and a quarter the entire set of attendees met as a group in an attempt to identify problems and issues that required more detailed discussion. An overview of what happened in these sessions is given in Section 1; Section 1.5 describes some conclusions based on these sessions. The rest of the workshop was spent in small working groups that focussed on specific issues. Each of these groups was charged with coming up with a set of proposed solutions to problems in the specific area they were addressing. Section 2 describes what happened in the working groups and the recommendations. Each session (whether attended by the entire group or a subgroup) had a scribe who was responsible for taking notes during that session and providing a written summary, and a session leader who led the discussion and reported on it at the final workshop session. The summaries are included in Appendix A. Information about the program committee and attendees is contained in Appendix B. GRA

N93-15878# Sandia National Labs., Albuquerque, NM.
THE SANDIA AIRBORNE COMPUTER (SANDAC)
E. J. Nava 1992 25 p Presented at the Symposium for High-performance Computing for Flight Vehicles, Washington, DC, 7-9 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE92-014046; SAND-92-0962C; CONF-921210-1) Avail: CASI HC A03/MF A01

The Sandia Airborne Computer (SANDAC) is a small, modular, high performance, multiprocessor computer originally designed for aerospace applications. It can use a combination of Motorola 68020 and 68040 based processor modules along with AT&T DSP32C based signal processing modules. The system is designed to use up to 15 processors in almost any combination and a complete system can include up to 20 modules. Depending on the mix of processors, total computational throughput can range from 2.5 to greater than 225 Million Instructions Per Second (MIPS). The system is designed so that processors can access all resources in the machine and the inter-processor communication details are completely transparent to the software. In addition to processors, the system includes input/output, memory, and special function modules. Because of its ease of use, small size, durability, and configuration flexibility, SANDAC has been used on applications ranging from missile navigation, guidance, and control systems to medical imaging systems. DOE

N93-15883# Los Alamos National Lab., NM.
LATIN HYPERCUBE SAMPLING AS A TOOL IN UNCERTAINTY: ANALYSIS OF COMPUTER MODELS
M. D. McKay 1992 9 p Presented at the 1992 Winter Simulation Conference, Arlington, VA, 13-16 Dec. 1992
(Contract W-7405-eng-36)
(DE92-018917; LA-UR-92-2338; CONF-921219-1) Avail: CASI HC A02/MF A01

This paper addresses several aspects of the analysis of uncertainty in the output of computer models arising from uncertainty in inputs (parameters). Uncertainty of this type, which is separate and distinct from the randomness of a stochastic model, most often arises when input values are guesstimates, or when they are estimated from data, or when the input parameters do not actually correspond to observable quantities, e.g., in lumped-parameter models. Uncertainty in the output is quantified in its probability distribution, which results from treating the inputs as random variables. The assessment of which inputs are important with respect to uncertainty is done relative to the probability distribution of the output. DOE

N93-15914# Eagle Technology, Inc., Arlington, VA.
CD-ROM APPLICATIONS IN PROFESSIONAL MILITARY EDUCATION (PME) Final Report, Sep. 1991 - May 1992
Kimberly Redmond, Joe Sheppard, Marlene Humphrey, and Lee Stacy Oct. 1992 99 p
(Contract N66001-89-D-0148)
(AD-A256662; NPRDC-TN-93-1) Avail: CASI HC A05/MF A02

This effort was conducted to identify the most cost-effective and efficient utilization of Compact Disk-read Only Memory (CD-ROM) within the Marine Corps Professional Military Education (PME) schools at the Marine Corps University (MCU). GRA

N93-16031# Brown Univ., Providence, RI. Dept. of Computer Science.
MULTIPARADIGM DESIGN ENVIRONMENTS Final Report
Eugene Charniak, Thomas L. Dean, Thomas W. Doeppner, Paris Kanellakis, and Dnaniel Lopresti 1992 30 p
(Contract N00014-83-K-0146; DARPA Order 4786; DARPA Order 6320)
(AD-A257149) Avail: CASI HC A03/MF A01

The goal of the research under the Multiparadigm Design Environments project was to develop prototype environments to support the design of complex software and VLSI systems. Research on this project has produced the following results: (1) New methods for programming in terms of conceptual models; (2) Design of object-oriented languages; (3) Compiler optimization and analysis techniques for high level languages, including object-oriented languages; (4) Design of an object-oriented database, including development of query languages and optimization methods; (5) Development of operating system support for parallel programming; (6) Algorithm development for I/O efficiency and incremental computation; (7) Determining the computational complexity of ML type inference; (8) A new architecture for programmable systolic arrays; and (9) New parallel algorithms for the graph partitioning problem and proof that key heuristics for it, including simulated annealing, are P-complete. We experimented with object-based methods for programming directly in terms of conceptual models, object-oriented language design, computer program optimization, and object-oriented database construction. We also examined the expressive power and optimization of database/programming languages, and the expression and exploitation of parallelism. The theoretical and experimental fruits of this research are being widely distributed and used, and we expect these results to have a strong influence on future design environments. GRA

N93-16347# Technische Univ., Eindhoven (Netherlands).
AN OBJECT-ORIENTED MODELLING TECHNIQUE FOR ANALYSIS AND DESIGN OF COMPLEX (REAL-TIME) SYSTEMS Ph.D. Thesis
Adrianus Cornelis Verschueren 1992 191 p
(ISBN-90-9005046-9; ETN-93-92883) Avail: CASI HC A09/MF A02

The purpose of the work is to describe how object oriented design methods can be applied to systems which contain a mix of software and hardware modules. An improved object model which allows designing systems which contain a high degree of concurrency is presented. The model can be simulated on a computer in an interactive design environment. Timing can be specified and simulated to check system performance. The complete system design path is split in three phases: high level system behavior analysis, high level system architecture synthesis, low level module architecture synthesis, and implementation. The characteristics common to the tools used for this design path are given. These tools are highly interactive and combine design and simulation. Simulation will not be interrupted while the designer modifies the system structure or entity behavior. Shortening the design-simulate-debug cycle gives a designer immediate feedback on design actions. Several design and simulation tools were implemented. ESA

N93-16621*# Rensselaer Polytechnic Inst., Troy, NY. Electrical, Computer, and Systems Engineering.
ARCHITECTURES FOR INTELLIGENT MACHINES
George N. Saridis Jul. 1991 36 p
(Grant NAGw-1333)
(NASA-CR-191875; NAS 1.26:191875; CIRSSE-96) Avail: CASI HC A03/MF A01

The theory of intelligent machines has been recently reformulated to incorporate new architectures that are using neural and Petri nets. The analytic functions of an intelligent machine are implemented by intelligent controls, using entropy as a measure. The resulting hierarchical control structure is based on the principle of increasing precision with decreasing intelligence. Each of the three levels of the intelligent control is using different architectures, in order to satisfy the requirements of the principle: the organization level is moduled after a Boltzmann machine for abstract reasoning, task planning and decision making; the coordination level is composed of a number of Petri net transducers supervised, for command exchange, by a dispatcher, which also serves as an interface to the organization level; the execution level, include the sensory, planning for navigation and control hardware which interacts one-to-one with the appropriate coordinators, while a VME bus provides a channel for database exchange among the several devices. This system is currently implemented on a robotic transporter, designed for space construction at the CIRSSE laboratories at the Rensselaer Polytechnic Institute. The progress of its development is reported. Author

N93-17681# Naval Postgraduate School, Monterey, CA.
A STUDY ON THE EFFECTIVENESS OF LOCKUP-FREE CACHES FOR A REDUCED INSTRUCTION SET COMPUTER (RISC) PROCESSOR M.S. Thesis
Leonard Tharpe Sep. 1992 138 p
(AD-A257662) Avail: CASI HC A07/MF A02

This thesis presents a simulation and analysis of the Reduced Instruction Set Computer (RISC) architecture, and the effects on RISC performance of a lockup-free cache interface. RISC architectures achieve high performance by having a small, but sufficient, instruction set with most instructions executing in one clock cycle. Current RISC performance range from 1.5 to 2.0 CPI. The goal of RISC is to attain a CPI of 1.0. The major hinderance in attaining that goal is attributed to instructions that require main memory access. In this thesis, we attempt to reduce the effects of

high penalties for non-cache accesses by using a non-blocking cache memory subsystem called a lockup-free cache. This interface between the cache and main memory prevents the processor from locking-up when a request from main memory occurs. This is accomplished by entering all non-cache requests into a memory queue, while the processor continues to issue and execute other instructions. The evaluation of the effects of the lockup-free cache interface is done using different variations of the interface design. The results show that using the lockup-free cache improves RISC performance. GRA

N93-17752# Defense Information Systems Agency, Arlington, VA. Center for Information Management.
HUMAN COMPUTER INTERFACE STYLE GUIDE, VERSION 1.0
John Keane 12 Feb. 1992 157 p
(AD-A253475) Avail: CASI HC A08/MF A01

The purpose of this style guide is to provide a common framework for Human Computer Interface (HCI) design and implementation. With this framework, the long-term goals, objectives, and requirements of HCI will be defined and documented. Interface implementation options will be standardized, enabling all DoD applications to appear and operate in a reasonably consistent manner. GRA

N93-16775*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
VIRTUAL REALITY SYSTEMS
David W. Johnson *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 130-132 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N93-15682# RAND Corp., Santa Monica, CA.
USER'S GUIDE FOR THE LONGITUDINAL SCALOGRAM ANALYSIS PROGRAM
Ron D. Hays 1991 28 p
(AD-A256817; RAND/N3260-1-CHF/RC) Avail: CASI HC A03/MF A01

This Note is the user's manual for the Longitudinal Scalogram Analysis (LSA) program. LSA is an extension of cross-sectional scalogram analysis to longitudinal data. The LSA program has been used on Project ALERT to model stages of drug use involvement in adolescents. This revision of the original Note adds new information about the computation of standard errors and provides an example illustrating different longitudinal scalogram results for the same prevalence rates. GRA

N93-15684# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
MICROMETER FX/DLX: A PEDAGOGIC COMPILER Ph.D. Thesis
Douglas Grundman, Raymie Stata, and James OToole Mar. 1992 167 p
(AD-A256821; MIT/LCS/TR-538) Avail: CASI HC A08/MF A02

This report provides an overview of the microns FX/DLX compiler. The source language for the compiler is microns FX, a Lisp dialect that is a subset of FX-91. Microns FX is statically typed, and employs a type reconstruction algorithm to eliminate the need for type declarations. The compiler produces assembly code for the DLX, a simplified RISC architecture introduced by Patterson and Hennessy in their text, Computer Architecture: A Quantitative Approach. Microns FX/DLX was written for the primary purpose of conducting experiments concerning basic features of programming language implementation. For example, it is used in the MIT graduate-level programming language course, where students are expected to read, understand, and modify the compiler, in order to investigate the effects of various optimizations. The organization of the compiler and its intermediate forms are described via examples. The register usage, memory layouts, and calling conventions are explained. Some suggested experiments are presented, and the annotated implementation of micron FX/DLX is provided. The report is not entirely self contained, as it does not completely describe the details of the source and target languages. GRA

N93-15693*# Sparta, Inc., Huntsville, AL.
DISTRIBUTED FINITE ELEMENT ANALYSIS USING A TRANSPUTER NETWORK Final Report
James Watson, James Favenesi, Albert Danial, Joseph Tombrello, Dabby Yang, Brian Reynolds, Ronald Turrentine, Mark Shephard (Rensselaer Polytechnic Inst., Troy, NY.), and Peggy Baehmann (Rensselaer Polytechnic Inst., Troy, NY.) Jul. 1989 151 p Original contains color illustrations
(Contract NAS3-25422)
(NASA-CR-190888; NAS 1.26:190888) Avail: CASI HC A08/MF A02; 7 functional color pages

The principal objective of this research effort was to demonstrate the extraordinarily cost effective acceleration of finite element structural analysis problems using a transputer-based parallel processing network. This objective was accomplished in the form of a commercially viable parallel processing workstation. The workstation is a desktop size, low-maintenance computing unit capable of supercomputer performance yet costs two orders of magnitude less. To achieve the principal research objective, a transputer based structural analysis workstation termed XPFEM was implemented with linear static structural analysis capabilities resembling commercially available NASTRAN. Finite element model files, generated using the on-line preprocessing module or external preprocessing packages, are downloaded to a network of 32 transputers for accelerated solution. The system currently executes at about one third Cray X-MP24 speed but additional acceleration appears likely. For the NASA selected demonstration problem of a Space Shuttle main engine turbine blade model with about 1500 nodes and 4500 independent degrees of freedom, the Cray X-MP24 required 23.9 seconds to obtain a solution while the transputer network, operated from an IBM PC-AT compatible host computer, required 71.7 seconds. Consequently, the $80,000 transputer network demonstrated a cost-performance ratio about 60 times better than the $15,000,000 Cray X-MP24 system. Author

N93-15818# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
THE DOMAIN-SPECIFIC SOFTWARE ARCHITECTURE PROGRAM Final Report
Erik Mettala and Marc H. Graham Jun. 1992 96 p
(Contract F19628-90-C-0003)
(AD-A257225; CMU/SEI-92-SR-9) Avail: CASI HC A05/MF A01

The DARPA Domain Specific Software Architecture Program (DSSA) is a five-year effort that has been active since July 1991. This document contains an overview of the work being done in the program as of July 1992. Software architectures serve as frameworks for software reuse. Domain-specific software architectures also serve as a common language in which domain engineers can discuss, understand, and teach the principles of their craft. There are six independent projects within the DSSA program. Four of these projects are working in specific, military-significant domains. GRA

N93-15841# Carnegie-Mellon Univ., Pittsburgh, PA. School of Computer Science.
COMPILING PROLOG TO STANDARD ML: SOME OPTIMIZATIONS
Luke Hornof 9 Sep. 1992 30 p
(AD-A256193; CMU-CS-92-166) Avail: CASI HC A03/MF A01

Using a high level language to develop a Prolog system offers many advantages. Development time is decreased, maintainability is increased, and modularity can be utilized. We used Standard ML to develop such a system due to its many powerful features, such as its efficient garbage collection and strong type checking. Of particular consideration was to determine the practicality of this high level system-whether or not a reasonable performance could be obtained. This paper focuses on the optimizations implemented which increase the performance of the system. They include Indexing, Last Call Optimization, Garbage Reduction, and String Compare. AH of the combined greatly enhance the performance of the system, which approaches that of a low-level implementation for certain types of programs. This report was submitted in partial fulfillment of the requirements for the Senior Honors Research Program in the School of Computer Science at Carnegie Mellon University. GRA

N93-15855# University of Southern California, Marina del Rey. Information Sciences Inst.

ATOMIC: A LOW-COST, VERY HIGH-SPEED LAN

D. Cohen, G. Finn, R. Felderman, and A. DeSchon Sep. 1992 27 p

(Contract DABT63-91-C-0001)

(AD-A257140; ISI/RR-92-291) Avail: CASI HC A03/MF A01

ATOMIC is an inexpensive 0 (gigabit) speed LAN built by USC/ISI. It is based upon Mosaic technology developed for fine-grain, message-passing, massively parallel computation. Each Mosaic processor is capable of routing variable length packets, while providing added value through simultaneous computing and buffering. ATOMIC adds a general routing capability to the native Mosaic wormhole routing through store-and-forward. ATOMIC scales linearly, with a small interface cost. Each ATOMIC channel has a data carrying capacity of 500 Mb/s. A prototype ATOMIC LAN has been constructed along with host interfaces and software that provides full TCP/IP compatibility. Using ATOMIC, 1,500 byte packets have been exchanged between hosts at an aggregate transfer rate of more than 1 Gb/s. Other tests have demonstrated throughput of 5.25 million packets per second over a single channel. This paper describes the architecture and performance of ATOMIC. GRA

N93-15863# Microelectronics and Computer Technology Corp., Austin, TX.

AN MCM/CHIP CONCURRENT ENGINEERING VALIDATION Quarterly Report No. 3, Jul. - Sep. 1992

Hector Moreno 30 Sep. 1992 26 p

(Contract MDA972-92-C-0022)

(AD-A257415; HVE-232-92) Avail: CASI HC A03/MF A01

A software link was established between three commercially available Multi-Chip Module design systems: Allegro, EDGE and Finesse. The link was implemented through a database system based on the ROSE system developed under the sponsorship of the DICE program. The code was written in C++ and uses various methods to feed the information in and obtain it out of the design systems: IGES for Allegro, SKILL for EDGE and d-file for Finesse. The DDR2 (Digital Drop Receiver, version 2) multi-chip module from Harris has been entered into the system and routed, and the information transferred to all the designers through the ROSE database. GRA

N93-15869# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.

THE DESIGN AND IMPLEMENTATION OF A PARALLEL PERSISTENT OBJECT SYSTEM

Michael L. Heytens Feb. 1992 238 p

(Contract N00014-89-J-1988)

(AD-A257447; MIT/LCS/TR-529) Avail: CASI HC A11/MF A03

It is widely recognized that the expressive power of relational database systems is inadequate for applications that manipulate complex, non record-oriented data. Much recent research has been focused on the design of more expressive database language models that seamlessly integrate the data modeling, abstraction, and general computation of full programming languages with the features of traditional database systems such as persistence, failure recovery, and security. Such additional flexibility gives expressive power to the programmer, but complicates matters for the compiler and run-time system in their efforts to implement database programs efficiently. AGNA, an experimental persistent object system is described that was designed and built that uses parallelism in a fundamental way to enhance performance. Parallelism is incorporated into the design of the system at all levels. We begin with an implicitly parallel transaction language that includes a full higher-order programming language and the List comprehension, a notation similar to SQL but more general. Transactions are compiled into code for a multi-threaded abstract machine called P.RISC, whose central feature is fine grain parallelism with data-driven execution. P-RISC code is emulated on each processor of a MIMD machine with multiple disks. GRA

N93-15893# British Columbia Univ., Vancouver. Dept. of Computer Science.

PROCEEDINGS OF THE ELEVENTH ANNUAL ACM SYMPOSIUM ON PRINCIPLES OF DISTRIBUTED COMPUTING Final Report

Norman C. Hutchinson 10 Aug. 1992 296 p Symposium held in Vancouver, Ontario, 10-12 Aug. 1992

(Contract N00014-92-J-1463)

(AD-A257294) Avail: CASI HC A13/MF A03

The proceedings of presented of the symposium. Some areas of concern are as follow: Performance Issues in Non-blocking Synchronization on Shared-Memory Multiprocessors; Robust Distributed References and Acyclic Garbage Collection; The Weakest Failure Detector for Solving Consensus; Improving Fast Mutual Exclusion; Fast Network Decomposition; Leader Election in Complete Networks; The Impact of Time on the Session Problem. GRA

N93-15894# Washington Univ., Seattle.

SPECIFYING, PREDICTING, AND VERIFYING THE TIMING PROPERTIES OF HARD-REAL-TIME PROGRAMMING LANGUAGES AND SYSTEMS Final Report

Alan C. Shaw 15 Jun. 1992 2 p

(Contract N00014-89-J-1040)

(AD-A257296) Avail: CASI HC A01/MF A01

The major research accomplishments supported by the grant were: (1) Predicting the Deterministic Timing Behavior of Programs - Much work was done in developing concepts and techniques to predict the deterministic execution times of sequential and parallel programs. This also included substantial experimental work and the construction of software tools to validate our ideas and methodology, especially for sequential programs. The basis for this work was our notion of source program timing schema that provided a machine-independent timing semantics for higher-level language software; (2) Specifying Requirements and Designs for Real-Time Systems - A new specification method, called communicating real-time state machines, was invented for describing requirements and designs of distributed real-time systems; (3) Other Research - We designed a methodology for the software engineering of real-time operating systems, based on a straightforward process/abstract-data-type (object) model, and built an operating system kernel using our scheme. GRA

N93-15902# Los Alamos National Lab., NM.

CMOR: A CONFIGURABLE MONITOR

M. A. Roschke 1992 8 p Presented at the Cray Users Group Meeting, Washington, DC, 14-18 Sep. 1992

(Contract W-7405-eng-36)

(DE92-040208; LA-UR-92-3037; CONF-9209204-1) Avail: CASI HC A02/MF A01

CMOR is a distributed, X window-based, monitoring program that can be used to graphically monitor data from a wide variety of sources, such as applications, network interfaces, and operating systems. CMOR is a component-based program that is designed to be executed without any programming on the part of the user. CMOR is designed to allow automatic reconfiguration while it is running. And CMOR is distributed, which allows monitored data to be obtained from the local machine or from a remote machine. DOE

N93-15907# Carnegie-Mellon Univ., Pittsburgh, PA. School of Computer Science.

TRANSPARENTLY INTERPOSING USER CODE AT THE SYSTEM INTERFACE Ph.D. Thesis

Michael B. Jones Sep. 1992 143 p

(Contract F33615-90-C-1465; ARPA Order 7597)

(AD-A256636; CMU-CS-92-170) Avail: CASI HC A07/MF A02

Many contemporary systems utilize a system call interface between the operating system and its clients. Increasing numbers of systems are providing low-level mechanisms for intercepting and handling system calls in user code. Nonetheless, they typically provide no higher-level tools or abstractions for effectively utilizing these mechanisms. Using them has typically required reimplementation of a substantial portion of the system interface from scratch, making the use of such facilities unwieldy at best. This dissertation presents a toolkit that substantially increases the ease of interposing user code between clients and instances of the system interface by allowing such code to be written in terms of the high-level objects provided by this interface, rather than in terms of the intercepted system calls themselves. This tool kit helps enable new interposition agents to be written, many of which would not otherwise have been attempted. This toolkit has also been used to construct several agents including: system call tracing tools, file reference tracing tools, and customizable file system

views. Examples of other agents that could be built include: protected environments for running untrusted binaries, logical devices implemented entirely in user space, transparent data compression and/or encryption agents, transactional software environments, and emulators for other operating system environments. GRA

N93-15929# Argonne National Lab., IL.
THE DESIGN OF THE AIE: AN OBJECT-ORIENTED APPLICATION DEVELOPMENT SYSTEM
R. S. Fuja and M. A. Widing 27 Feb. 1992 20 p Presented at the Conference on Object-Oriented Programming Systems, Languages, and Applications, Vancouver, Ontario, 18-22 Oct. 1992
(Contract W-31-109-eng-38)
(DE92-041098; ANL/CP-75674; CONF-921084-2) Avail: CASI HC A03/MF A01

Three years ago, in response to our challenging development context, the Advanced Modeling and Analysis Section designed and implemented an object-oriented environment (the Application Interface Engine: AIE). Our prototyping requirements forced existing application development systems beyond their capabilities. Programmers at AMAS and its contractors have developed over twenty applications using AIE. Our initial experience has been very positive. AIE extends an object-oriented programming language with syntax and classes to support applications specification. This extended system improves all stages of the application engineering life cycle, from rapid prototyping to long term maintenance. DOE

N93-15962# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
SOFTWARE MEASURES AND THE CAPABILITY MATURITY MODEL Final Report
John H. Baumert and Mark S. McWhinney Sep. 1992 297 p
(Contract F19628-90-C-0003)
(AD-A257238; CMU/SEI-92-TR-25; ESC-TR-92-025) Avail: CASI HC A13/MF A03

This document describes a set of software measures that are compatible with the measurement practices described in the Capability Maturity Model for Software. These measures, in the form of software indicators, cover thirteen different categories that include progress, effort, cost, and quality. Each indicator category contains example figures which illustrate behavior that may occur on a project. The text provides users with tips on how to use these figures or similar ones on their projects. Project software managers and software engineering process groups can use these indicators during the software development life cycle to gain insight into the software development process and software process improvement activities. The indicators chosen have been successfully used on projects in the software industry. GRA

N93-15992# Naval Postgraduate School, Monterey, CA.
NPSGDL: AN OBJECT ORIENTED GRAPHICS DESCRIPTION LANGUAGE FOR VIRTUAL WORLD APPLICATION SUPPORT M.S. Thesis
Kalin P. Wilson Sep. 1992 150 p
(AD-A257337) Avail: CASI HC A07/MF A02

Many virtual world applications today represent the cutting edge in real-time 3D interactive graphics. Virtual world applications must model many complex, often changing, graphical objects. These graphical objects must be modeled both visually and behaviorly. The performance of most applications of this nature is determined by the graphics processing capabilities of the hardware used. An efficient, application independent method for describing and managing graphical objects is essential for rapid prototyping and development of robust virtual world applications. This thesis presents an efficient, flexible and extensible graphics description system, NPSGDL, used in virtual world development at the Naval Postgraduate School. GRA

N93-16000# Vanderbilt Univ., Nashville, TN.
CAPS REREADER SIMULATION MODEL USER'S MANUAL VERSION 1.0 Technical Report, 1 May 1991 - 30 Apr. 1992
Julio Ortega, Elizabeth U. Saul, Sashank Varma, and Susan R. Goldman 29 Oct. 1992 62 p
(Contract N00014-91-J-1769)
(AD-A257180) Avail: CASI HC A04/MF A01

CAPS ReReader is a computer program that simulates the process and products of reading comprehension. The input to ReReader is a representation of a text plus the representation of some minimal knowledge that a human would need for the comprehension of the text. A simulation run of ReReader produces traces of the reading behavior of a hypothetical reader and outputs a set of long term memory strengths for the text information. The results of the traces can be analyzed and compared with reading behavior and recall data collected from human subjects reading the same text. ReReader currently runs on a VAX workstation running under the VMS operating system. ReReader Version 1.0 uses two User interfaces: One permits the User to set the parameters for a simulation run; the other is for specifying different data report forms. This User Manual has four sections plus appendices of technical information: Section 1 describes ReReader's text processing model. Section 2 explains how to run a ReReader simulation. Section 3 explains how to obtain and interpret the output of a ReReader simulation with the help of the ReReader Report interface. Advanced features of the ReReader simulator are described in section four. GRA

N93-16049# Mei Associates, Inc., Lexington, MA.
FUNCTIONAL REQUIREMENTS OF AN ADVANCED INSTRUCTIONAL DESIGN ADVISOR. VOLUME 1: EPITOMIZING FUNCTIONS Interim Technical Report, Feb. 1991 - May 1992
Robert D. Tennyson, Charles R. Reigeluth, and Dennis J. Gettman Sep. 1992 72 p Prepared in cooperation with Minnesota Univ., and Indiana Univ. See also Volume 3, AD-A256 650
(Contract F33615-88-C-0003)
(AD-A256752; AL-TP-1992-0035-Vol-1) Avail: CASI HC A04/MF A01

The Advanced Instructional Design Advisor (AIDA) will provide automated and intelligent assistance to inexperienced computer-based instruction developers. This report outlines initial development of a prototype or XAIDA as opposed to development of a complete automated Instructional System Design (ISD) expert system. One of the difficulties in automating-instructional design is with the proper application of ISD. The first part of this paper offers a detailed description of a potential ISD model for XAIDA in which three basic forms of knowledge, declarative, procedural, and contextual, are directly tied to instructional strategies. The final section of the paper specifies conditions for the development of XAIDA. This 'epitomizes' XAIDA by presenting general 'simplifying conditions' to restrict such things as task, time to teach, learning level, medium, environment, and instructional strategy. The final portion of this paper applies these general conditions to a specific task by outlining the development of a lesson for the T-38 engine starting system. GRA

N93-16056# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
ASPECT: A FORMAL SPECIFICATION LANGUAGE FOR DETECTING BUGS M.S. Thesis
Daniel Jackson Jun. 1992 162 p
(Contract N00014-89-J-1988; NSF CCR-89-10848)
(AD-A256797; MIT/LCS/TR-543) Avail: CASI HC A08/MF A02

Aspect is a static analysis technique based on formal specifications. By trading expressive power for tractability, Aspect can offer efficient detection of a class of bugs that is not detectable by other static means. Since the specifications are partial, not all bugs can be caught. But there are never any spurious reports: an error message always indicates an error in the code or a flaw in the specification. Aspect can handle most of the features of modern imperative programming languages: side-effects and aliasing, exceptions, polymorphism and dynamic allocation. It takes advantage of strong typing and is designed for programs that are organized around procedures and abstract types. The checking mechanism is based on an enriched form of dependency analysis. Objects are divided into projections called 'aspects'; the dependencies of different aspects are then tracked individually. The analysis is comparable in complexity to the kinds of analysis already performed by optimizing compilers. A prototype checker has been implemented for the CLU programming language. It runs almost as fast as the compiler, and has found a variety of bugs in real programs. GRA

N93-16057# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
REPORT ON THE FX-91 PROGRAMMING LANGUAGE

David K. Gifford, Pierre Jouvelot, Mark A. Sheldon, and James W. OToole
Feb. 1992 28 p
(Contract N00014-89-J-1988)
(AD-A256798; MIT/LCS/TR-531) Avail: CASI HC A03/MF A01

This report gives a defining description of the programming language FX-91. The FX (short for FX-91) programming language is designed to support the parallel implementation of applications that perform both symbolic and scientific computations. The unique features of FX include: (1) An effect system, to discover expression scheduling constraints. An effect is a static description of the side-effects an expression may perform when it is evaluated. Just as a type describes what an expression computes, an effect describes how an expression computes; (2) Abstraction over any kind of description, thus permitting first-class type and effect polymorphism. Effect polymorphism makes the FX effect system more powerful than previous approaches to side-effect analysis in the presence of first-class subroutines; (3) Type and effect inference, so that declaration free programs can be statically type and effect checked. FX also permits explicitly typed programs, and programs that use explicit types only for first-class polymorphic values and modules; and (4) First-class modules, which permit FX to serve as its own configuration language. It also includes an architecture independent module of parallel vector operators. GRA

N93-16069# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Computer Science.
A MODULE SYSTEM FOR A PROGRAMMING LANGUAGE BASED ON THE LF LOGICAL FRAMEWORK
Robert Harper and Frank Pfenning Sep. 1992 32 p
(Contract F33615-90-C-1465; ARPA Order 7597)
(AD-A256731; CMU-CS-92-191) Avail: CASI HC A03/MF A01

We describe a module system for Elf, a logic programming language based on the LF logical framework. The static part of module calculus addresses name-space management and structured presentation of deductive systems. The dynamic part addresses search-space management and modularization of logic programs. GRA

N93-16089# Massachusetts Univ., Amherst.
COMPUTATION AND GRAPHICS IN MATHEMATICAL RESEARCH
D. A. Hoffman and J. Spruck 13 Aug. 1992 49 p
(Contract DE-FG02-86ER-25015)
(DE92-040652; DOE/ER-25015/31) Avail: CASI HC A03/MF A01

This report discusses the description of the GANG Project and results for prior research; the center for geometry, analysis, numerics and graphics; description of GANG Laboratory; software development at GANG; and mathematical and scientific research activities. DOE

N93-16108# Memphis State Univ., TN. Dept. of Psychology.
QUESTIONING MECHANISMS DURING TUTORING, CONVERSATION, AND HUMAN-COMPUTER INTERACTION Status Report No. 1, 16 Jun. - 1 Oct. 1992
14 Oct. 1992 4 p
(Contract N00014-92-J-1826)
(AD-A257214) Avail: CASI HC A01/MF A01

Work performed during the report period June 1992 to October 1992 is highlighted. An in-depth analysis of the tutoring protocols of college students who were learning research methods was performed. These analyses examine the collaborative exchange and feedback mechanisms when a tutor asks deep-level questions, definitional questions, and short-answer questions. Focus is on the feedback that tutors give to the students answers because earlier analyses indicated that this feedback (positive, negative, neutral) was uncorrelated with the quality of the students' answers (completely correct, partially correct, vague, versus error-ridden). The hesitations and pauses of tutor feedback, which might signal feedback at a paralinguistic level are analyzed. The extent to which tutor questions are formulated to diagnose and repair student errors or to implement curriculum scripts is analyzed. Also, tutoring strategies at a macro-level are analyzed. In another project, the sequences of speech act categories in dialogues between children are analyzed. Papers and books published and presentations made are listed. L.R.R.

N93-16109# Department of Energy, Morgantown, WV. Energy Technology Center.
THE IEEE-488 INTERFACE TO PARAGON 500 PROCESS CONTROL SOFTWARE
J. D. Thornton Jun. 1992 22 p
(DE92-001289; DOE/METC-92-4111) Avail: CASI HC A03/MF A01

An IEEE-488 interface has been developed to link the NEFF 470 Data Acquisition Hardware to the Paragon 500 Process Control Software. This interface allows the user to use the features within Paragon 500 to display data from the Data Acquisition Hardware. Furthermore, by using Paragon 500 software to perform Automated Process Control, the networking capabilities of Paragon 500 allows the Process Control System to monitor real-time data from the Data Acquisition System via an Ethernet Network connection. This allows remote access to process variable data from any Paragon station configured on that network. DOE

N93-16174# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Statistics.
FAULT TOLERANT REAL-TIME SYSTEMS Report, 1 Oct. 1991 - 30 Sep. 1992
John P. Lehoczky 30 Sep. 1992 12 p
(Contracts N00014-84-K-0734; N00014-92-J-1771)
(AD-A257352) Avail: CASI HC A03/MF A01

The ART (Advanced Real-Time Technology) Project is engaged in wide ranging research on hard real-time systems. The project has as its overall goal the development and demonstration of predictable and fault tolerant hard real-time computer systems. To achieve this goal, research is being conducted in three interrelated areas: (1) The development of a theory of hard real-time resource management including scheduling and synchronization (In addition, this theory is being applied in a wide range of contexts including databases, communication networks and operating systems); (2) The design and construction of an operating system (ARTS 2.0) that supports predictable and fault tolerant real-time computer systems and demonstration and testing in the ARTS testbed to provide proof of concept and to gain understanding into aspects of the theory needing further refinement; and (3) Development of hardware architectures and approaches to fault tolerance that can support predictable hard real-time computer systems. GRA

N93-16288# Alenia Spazio S.p.A., Naples (Italy). Tecnologia del Volo, Aerodinamica.
AN ADVANCED GRAPHICS-INTERACTIVE SYSTEM FOR A MULTI-BLOCK STRUCTURED GRID GENERATION WITHIN AN INDUSTRIAL ENVIRONMENT
A. Amendola, R. Tognaccini, and P. L. Vitagliano 1991 12 p
(ETN-92-92885) Avail: CASI HC A03/MF A01

A grid generation procedure embedded in a flow simulation system suitable for the analysis of a complex aerodynamic shape like an aircraft is described. The procedure is based on a multiblock approach and incorporates new technical concepts like discontinuous grid lines across block boundaries, local grid refinement, unstructured blocks packing, hyperblocks, zonal flow models. These improvements are aimed at increasing the system flexibility and easing the manipulation of complicated configurations while at the same time enhancing flow simulation accuracy. The complexity of the system is very high, but the required user effort is made realistic by the extensive applications of graphic interactive tools. It is pointed out that preliminary tasks like geometry modeling and domain decomposition are the actual critical items within the overall grid generation process. ESA

N93-16290# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
INTEGRATED AUTOMATION FOR SUPPORT OF RESEARCH AND DEVELOPMENT
W. Loeve 31 Oct. 1988 30 p Presented at the NEC Supercomputer Users Conference, Tokyo, Japan, 10-11 Nov. 1988
(NLR-MP-88063-U; ETN-93-92852) Avail: CASI HC A03/MF A01

For cost effective research and development in computational fluid dynamics, a cooperation of computer scientists and aerodynamicists is required. For control of this cooperation, a phased approach of development of computational fluid dynamics software and a technical concept for organization of the software is presented. How a centralized automation concept makes it possible also for small organizations to operate powerful

supercomputers in a cost effective way is described. Resource sharing and information sharing is the basis of the automation policy. Only in this way did it appear possible to obtain and maintain the required powerful computer capacity. It also is a prerequisite for realization of the large amount of software that is required for advanced simulation in aircraft and spacecraft engineering. ESA

N93-16295# Lawrence Livermore National Lab., CA.
BEEMER: AN INTEGRATED OPTICS DESIGN TOOL
J. S. Kallman and R. J. Hawkins Apr. 1992 57 p
(Contract W-7405-eng-48)
(DE92-040401; UCRL-MA-110645) Avail: CASI HC A04/MF A01

The BEEMER program is a tool for the computer aided design and simulation of integrated optic systems. BEEMER allows users to enter, simulate, and change a design with a turnaround time on the order of minutes. The program was written in order to free optics designers from the task of rewriting their simulation codes whenever they wanted to change a parameter of a simulation, and so lets the user manipulate every parameter possible. In addition, the program was meant to be used as a teaching tool, so the program comes up with common sense defaults for most parameters. The BEEMER program uses the Beam Propagation method to simulate the passage of electromagnetic waves through a set of waveguides. An excellent review of this method is available in Feit and Fleck's 'Beam nonparaxiality, filament formation, and beam breakup in the self-focusing of optical beams', in the Journal of the Optical Society of America B, Volume 5, page 633, March 1988. DOE

N93-16336# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
EXPERIMENTS WITH AN INCREMENTAL CLOSURE ALGORITHM
Rieks opdenAkker and Petr Pavlu (Czech Technical Univ., Prague.) Apr. 1992 26 p Sponsored by Commission of the European Communities
(Memo-INF-92-33; ETN-92-92445) Copyright Avail: CASI HC A03/MF A01

Algorithms for the efficient incremental computation of the transitive closure of a directed graph, that is subjected to edge insertions and/or edge deletions, are discussed. Experiments with the algorithms support the analytical results that incremental computation of the transitive closure using the algorithms presented is often more efficient, but sometimes as costly as the computation from scratch. ESA

N93-16338# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
MGMTOOL: A PERFORMANCE MODELLING TOOL BASED ON MATRIX GEOMETRIC TECHNIQUES
Boudewijn R. Haverkort, Aad P. A. vanMoorsel, and Arvid Dijkstra 1992 24 p
(Memo-INF-92-35; TIOS-92/15; ETN-92-92447) Copyright Avail: CASI HC A03/MF A01

MGMtool, a Matrix Geometric Method (MGM) performance analysis tool which allows its users to easily specify queueing systems in terms of interarrival and service time distributions, is presented. MGMtool takes care of the translation of this description to an underlying Markov chain that exhibits a matrix geometric solution. Subsequently, MGMtool takes care of the derivation of the measures specified by the user. A particular measure of interest that can be derived is the caudal curve. These measures gives insight into the 'tail behavior' of the queue. With MGMtool, models are specified via C procedure calls. This turns out to be a very flexible approach for modeling queueing systems; it also allows for the easy evaluation of models over parameter ranges. The underlying mathematics of MGMtool and various architectural and implementation issues are presented. In the examples, the use of MGMtool for modeling Markov modulated Poisson processes and various other interarrival and service time distributions is shown. ESA

N93-16339# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
GEOMETRIC CONSTRAINT SATISFACTION
Remco C. Veltkamp and Farhad Arbab Sep. 1991 27 p Sponsored by Netherlands Organization for Applied Scientific Research
(Grant NWO-NF-51/62-514)
(CWI-CS-R9141; ETN-92-92484) Copyright Avail: CASI HC A03/MF A01

An overview of geometric constraint satisfaction techniques and a new incremental approach that is suitable for interactive design are presented. This approach categorizes solutions into so called quanta. A quantum is a range of solutions with uniform geometric characteristics. Using this approach a system can keep the intermediate solutions in the geometric domain, and new geometric constraints can be interpreted on the same level of abstraction. Propagation of information is performed by 'propagation of known states', and the information results from 'solution set inference'. A solution set is represented in geometrical form by unions and intersections of quantum labels. This approach leads to a number of advantages including: handling of underconstrained specifications; the ability to perform satisfaction locally and incrementally; support of constraint inference and geometric reasoning; and preserving the declarative semantics of constraints. ESA

N93-16344# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
THE POSITION OF THE MATHEMATICIAN IN THE DEVELOPMENT OF DIGITAL SIMULATION SYSTEMS WITH APPLICATION TO COMPUTATIONAL PHYSICS [DE PLAATS VAN DE WISKUNDIGE BIJ DE ONTWIKKWLING VAN DIGITALE SIMULATIE-SYSTEMEN VOOR TOEPASSINGEN UIT DE 'COMPUTATIONAL PHYSICS']
A. J. vanderWees and J. I. vandenBerg 2 May 1990 18 p In DUTCH Presented at Nijmegen Univ. Mathematical Congress, Nijmegen, Netherlands, 20 Apr. 1990
(NLR-TP-90168-U; ETN-93-92861) Avail: CASI HC A03/MF A01

The role of the mathematician in applied scientific research for use in the aerospace industry is outlined. In many cases, the product has the form of an information system for the design, production, and usage of aerospace vehicles. Within this context the mathematician contributes to the development of these systems, in cooperation with specialists for other disciplines such as aerodynamics, structures, aviation, and aerospace. The mathematician is responsible for the numerical aspects of the system. An important aspect is the validation of software on its usefulness in applications. ESA

N93-16364# Sandia National Labs., Albuquerque, NM.
AN IMPROVED SPECTRAL GRAPH PARTITIONING ALGORITHM FOR MAPPING PARALLEL COMPUTATIONS
B. Hendrickson and R. Leland Sep. 1992 25 p
(Contract DE-AC04-76DP-00789)
(DE93-002593; SAND-92-1460) Avail: CASI HC A03/MF A01

Efficient use of a distributed memory parallel computer requires that the computational load be balanced across processors in a way that minimizes interprocessor communication. We present a new domain mapping algorithm that extends recent work in which ideas from spectral graph theory have been applied to this problem. Our generalization of spectral graph bisection involves a novel use of multiple eigenvectors to allow for division of a computation into four or eight parts at each stage of a recursive decomposition. The resulting method is suitable for scientific computations like irregular finite elements or differences performed on hypercube or mesh architecture machines. Experimental results confirm that the new method provides better decompositions arrived at more economically and robustly than with previous spectral methods. We have also improved upon the known spectral lower bound for graph bisection. DOE

N93-16365# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
AN OVERVIEW OF MANIFOLD AND ITS IMPLEMENTATION
F. Arbab, I. Herman, and P. Spilling Sep. 1991 39 p Sponsored by Netherlands Organization for Applied Scientific Research
(CWI-CS-R9142; ETN-92-92485) Copyright Avail: CASI HC A03/MF A01

Management of the commmunications among a set of concurrent processes arises in many applications and is a central concern in parallel computing. The MANIFOLD language is introduced: a language to describe and manage complex interconnections among independent, concurrent processes. In this language the primary concern is not with what functionality the individual processes in a parallel system provide. The emphasis is on how these processes are interconnected and how their interaction patterns

change during the execution life of the system. An overview of the implementation of MANIFOLD is included. The example of a window system is given and it is shown how the communications between clients running on different windows and a window server can be described in this language. The main motivations behind the language and its underlying computing model are discussed. A detailed description of the language is presented. Some of the application areas where MANIFOLD can prove to be a useful tool are mentioned. The major issues in the implementation of MANIFOLD are discussed and a solution approach is sketched. The implementation scheme is based on the notion of an abstract machine that makes no assumptions about the actual architecture of the underlying parallel system. ESA

N93-16369# Nijmegen Univ. (Netherlands). Dept. of Informatics.
THE MANY DISGUISES OF ACCUMULATION
Eerke Boiten Dec. 1991 18 p
(Grant NF-63/62-518)
(TR-91-26; ETN-93-92810) Avail: CASI HC A03/MF A01

Several descriptions of basically one transformation technique, accumulation, are compared. The accumulation transformation is, in a purely algebraic view, the exploitation of the properties of a monoid. Their basis, the associativity and the existence of a neutral element inherent in a monoid, is identified. ESA

N93-16380*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SOFTWARE ENGINEERING LABORATORY SERIES: ANNOTATED BIBLIOGRAPHY OF SOFTWARE ENGINEERING LABORATORY LITERATURE
Linda Morusiewicz (Computer Sciences Corp., Greenbelt, MD.) and Jon Valett Nov. 1992 260 p
(NASA-TM-108100; NAS 1.15:108100; SEL-82-1106) Avail: CASI HC A12/MF A03

This document is an annotated bibliography of technical papers, documents, and memorandums produced by or related to the Software Engineering Laboratory. More than 100 publications are summarized. These publications cover many areas of software engineering and range from research reports to software documentation. This document has been updated and reorganized substantially since the original version (SEL-82-006, November 1982). All materials have been grouped into eight general subject areas for easy reference: (1) the Software Engineering Laboratory; (2) the Software Engineering Laboratory: Software Development Documents; (3) Software Tools; (4) Software Models; (5) Software Measurement; (6) Technology Evaluations; (7) Ada Technology; and (8) Data Collection. This document contains an index of these publications classified by individual author. Author

N93-16383*# Calspan-State Univ. of New York Joint Venture, Buffalo, NY.
THEORETICAL CONSTRAINTS IN THE DESIGN OF MULTIVARIABLE CONTROL SYSTEMS Progress Report, 1 Jul. - 1 Sep. 1992
E. G. Rynaski, D. Joseph Mook, and Juan Depena 1 Sep. 1991 30 p
(Grant NAG1-1361)
(NASA-CR-191943; NAS 1.26:191943) Avail: CASI HC A03/MF A01

The research being performed under NASA Grant NAG1-1361 involves a more clear understanding and definition of the constraints involved in the pole-zero placement or assignment process for multiple input, multiple output systems. Complete state feedback to more than a single controller under conditions of complete controllability and observability is redundant if pole placement alone is the design objective. The additional feedback gains, above and beyond those required for pole placement can be used for eignevalue assignment or zero placement of individual closed loop transfer functions. Because both poles and zeros of individual closed loop transfer functions strongly affect the dynamic response to a pilot command input, the pole-zero placement problem is important. When fewer controllers than degrees of freedom of motion are available, complete design freedom is not possible, the transmission zeros constrain the regions of possible pole-zero placement. The effect of transmission zero constraints on the design possibilities, selection of transmission zeros and the avoidance of producing non-minimum phase transfer functions is the subject of the research being performed under this grant. Author

N93-16410# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
THE FAILURE OF FAILURES IN A PARADIGM FOR ASYNCHRONOUS COMMUNICATION
F. S. deBoer (Technische Univ., Eindhoven, Netherlands), J. N. Kok (Utrecht State Univ., Netherlands), C. Palamidessi (Utrecht State Univ., Netherlands), and J. J. M. M. Rutten Oct. 1991 22 p Submitted for publication Sponsored in part by Commission of the European Communities; Netherlands Research and Education in Concurrent Systems Project; and Netherlands Organization for Applied Scientific Research
(CWI-CS-R9147; ETN-92-92488) Copyright Avail: CASI HC A03/MF A01

A framework for a variety of concurrent languages all based on asynchronous communication, is presented. The main characteristic of these languages is that processes interact by reading and modifying the state of some common data structure. The specific features of the various communication mechanisms are obtained by means of a uniform language where actions are interpreted as partially defined transformations in an abstract set of states. Suspension is modeled by an action being undefined in a state. The languages can be obtained by fixing a specific set of states and interpretation of the actions. The computational model of the paradigm is described by a transition system. A compositional model based on traces is presented. The model is shown to be more abstract than the standard failure set semantics. The problem of full abstraction, with respect to various observation criteria, is investigated. The particular features of the specific languages are considered. For some cases studied, a fully abstract semantics is given. ESA

N93-16429*# Analex Corp., Brook Park, OH.
ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE HIGH BURST RATE LINK EVALUATION TERMINAL EXPERIMENT CONTROL AND MONITOR SOFTWARE MAINTENANCE MANUAL, VERSION 1.0 Final Report
Richard C. Reinhart Dec. 1992 128 p
(Contract NAS3-25776; RTOP 650-60-23)
(NASA-CR-189161; E-6982; NAS 1.26:189161) Avail: CASI HC A07/MF A02

The Experiment Control and Monitor (EC&M) software was developed at NASA Lewis Research Center to support the Advanced Communications Technology Satellite (ACTS) High Burst Rate Link Evaluation Terminal (HBR-LET). The HBR-LET is an experimenter's terminal to communicate with the ACTS for various investigations by government agencies, universities, and industry. The EC&M software is one segment of the Control and Performance Monitoring (C&PM) software system of the HBR-LET. The EC&M software allows users to initialize, control, and monitor the instrumentation within the HBR-LET using a predefined sequence of commands. Besides instrument control, the C&PM software system is also responsible for computer communication between the HBR-LET and the ACTS NASA Ground Station and for uplink power control of the HBR-LET to demonstrate power augmentation during rain fade events. The EC&M Software User's Guide, Version 1.0 (NASA-CR-189160) outlines the commands required to install and operate the EC&M software. Input and output file descriptions, operator commands, and error recovery procedures are discussed in the document. The EC&M Software Maintenance Manual, Version 1.0 (NASA-CR-189161) is a programmer's guide that describes current implementation of the EC&M software from a technical perspective. An overview of the EC&M software, computer algorithms, format representation, and computer hardware configuration are included in the manual. Author

N93-16440*# Environmental Research Inst. of Michigan, Ann Arbor. Space Automation and Robotics Center.
ROMPS CRITICAL DESIGN REVIEW. VOLUME 3: FURNACE MODULE DESIGN DOCUMENTATION
M. E. Dobbs Dec. 1992 84 p
(Grant NAG5-1517)
(NASA-CR-191615; NAS 1.26:191615; Rept-238800-11-T-Vol-3) Avail: CASI HC A05/MF A01

As part of the furnace module design documentation, the furnace module Easylab programs definitions and command variables are described. Also included are Easylab commands flow charts and fault conditions. L.R.R.

N93-16447# IIT Research Inst., Bartlesville, OK.
GENERAL-PURPOSE AUTOMATION PROGRAMMING: A CASE STUDY ON USING A GRAPHIC LANGUAGE
S. M. Mahmood and D. K. Olsen Oct. 1992 42 p
(Contract DE-FC22-83FE-60149)
(DE92-001071; NIPER-596) Avail: CASI HC A03/MF A01

Object-oriented programming is the future direction of computer programming and automation. It provides fast, easy and very reliable methodology for developing large complicated software programs to test prototype configurations and develop computer control of multiple operations. This report is part of technology transfer to assist the petroleum industry and other engineering, science and manufacturing areas by conveying background information and the benefits of this approach that were acquired during development of the data acquisition/control/analysis/presentation software to operate a high-temperature, high-pressure steamflood laboratory. NIPER developed the background and extensive applications using object-oriented programming software using National Instruments (tmk) LabVIEW (reg sign) 2 as the programming platform. The objective of developing this software was to automate the thermal lab; however, it was designed in such a way that the program would be general and could be configured to any laboratory automation during the run time. This modular program has been constructed so that application, with minor modification, can be used in other laboratory, pilot plant or commercial operations for data acquisition/control/analysis/presentation. DOE

N93-16471# Technische Univ., Eindhoven (Netherlands).
TOPICS: A CONTRIBUTION TO ANALOG DESIGN AUTOMATION Ph.D. Thesis
Dominicus Martinus W Leenaerts 1992 149 p
(ISBN-90-9004786-7; ETN-92-92817) Copyright Avail: CASI HC A07/MF A02

Some problems which arise in the course of automation of analog circuits are solved, with emphasis on problems in the synthesis process. To demonstrate the usefulness of the obtained results within the hierarchical design environment, a computer aided design tool, named TOPICS (Topdown Integrated Circuit Synthesis system), was developed. In the synthesis process, one of the main problems is to control the large degree of freedom. This problem can be treated to find all solutions of sets of (in)equalities. A method to solve the generalized situation is developed. The algorithm guarantees to find the solutions within a finite number of steps. This method is extended to be used in a hierarchical environment. For this situation, all solutions for a certain level are obtained, which are consistent with solutions, obtained at higer (lower) levels. To be able to handle a broad class of circuits, TOPICS uses a nonfixed topology structure. Experiments demonstrate that the design philosophy TOPICS relies on appear to be adequate. The proposed theories and techniques are evaluated and yield a positive impression. The methods are generally applicable and can be used to advantage in the automation of analog circuit design. ESA

N93-16500# Mei Associates, Inc., San Antonio, TX.
FUNCTIONAL REQUIREMENTS OF AN ADVANCED INSTRUCTIONAL DESIGN ADVISOR: SIMULATION AUTHORING, VOLUME 3 Interim Report, Mar. 1990 - Feb. 1991
M. D. Merrill, Mark K. Jones, Douglas M. Towne, and Earl R. Nason Sep. 1992 131 p Prepared in cooperation with Utah State Univ., Logan and University of Southern California, Los Angeles
(Contract F33615-88-C-0003)
(AD-A256650; AL-TP-1992-0035-Vol-3) Avail: CASI HC A07/MF A02

The Advanced Instructional Design Advisor (AIDA) will provide automated and intelligent assistance to inexperienced instructional computer-based instructional developers. Two reports are presented which discuss simulation capability and AIDA. First, Drs. M. David Merrill and Mark K. Jones describe the integration of transaction shells (TAX) with RAPIDS, a simulation-based instructional authoring and delivery system. They argue RAPIDS could be used to build simulations and some portions of the knowledge representation model required by AIDA. Merrill and Jones present an example of the instructional design process using the AIDA transaction shells. Then, Dr. Douglas Towne discusses the instructional development process using the RAPIDS system. Towne describes specifying course structure, building device simulations, producing simulations and delivering instruction using RAPIDS. He walks through the RAPIDS instructional development process using instruction on the maintenance of the U.S. Air Force T-38 jet aircraft as an example. Two significant conclusions resulted from this work. First, incorporating RAPIDS into the AIDA experimental prototype (AIDA) would be too costly and time-consuming. Second, because AIDA does require some simulation creation capability, a simpler simulation authoring capability will be included in the near term version of the system. GRA

N93-16511# Naval Research Lab., Orlando, FL. Underwater Sound Reference Detachment.
DATA MANIPULATION PACKAGE USING PV-WAVE. PRECISION VISUAL'S WORKSTATION ANALYSIS AND VISUALIZATION ENVIRONMENT Final Report, Oct. 1991 - May 1992
C. M. Siders, M. J. Parker, and D. M. Bolling (TRI/TESSCO, Inc., Austin, TX.) 15 Oct. 1992 27 p
(Contract N00014-89-C-2177)
(AD-A256513; NRL-MR-7105) Avail: CASI HC A03/MF A01

The Data Manipulation Package (DMP) is a computer program that was written in the PV-WAVE con-and language. PV-WAVE is a high level data analysis and graphics programming language that is useful in data manipulation and graphical presentations. Unfortunately, to use the PV-WAVE language effectively, the user must be familiar with virtually hundreds of commands, functions, procedures and system variables. The DMP program was developed to facilitate the use of PV-WAVE by non-programmers by providing a menu-driven user interface. The capabilities supported by DMP are subdivided into four categories: plotting, curvefitting, data manipulation, and statistical calculations. Each of these categories has many options that are described in detail in this report. DMP is written to be as portable as the PV-WAVE program itself. DMP was written for use on Digital Equipment Corporation's VMS machines, as well as-most UNIX based workstations. GRA

N93-16532# Brookhaven National Lab., Upton, NY.
UNIFORM CONVERGENCE ESTIMATES FOR MULTIGRID V-CYCLE ALGORITHMS WITH LESS THAN FULL ELLIPTIC REGULARITY
J. H. Bramble and J. E. Pasciak Mar. 1992 10 p Presented at the 6th International Conference on Domain Decomposition Methods in Science and Engineering, Como, Italy, 14-21 Jun. 1992
(Contract DE-AC02-76CH-00016)
(DE92-041275; BNL-47892; CONF-9206290-1) Avail: CASI HC A02/MF A01

In this paper, we provide uniform estimates for V-cycle algorithms with one smoothing on each level. This theory is based on some elliptic regularity but does not require a smoother interaction hypothesis (sometimes referred to as a strengthened Cauchy Schwarz inequality) assumed in other theories. Thus, it is a natural extension of the full regularity V-cycle estimates provided by Braess and Hackbush. DOE

N93-16550*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
PARALLEL ALGORITHMS FOR SIMULATING CONTINUOUS TIME MARKOV CHAINS Final Report
David M. Nicol (College of William and Mary, Williamsburg, VA.) and Philip Heidelberger (IBM Watson Research Center, Yorktown Heights, NY.) Nov. 1992 24 p Submitted for publication
(Contracts NAS1-18605; NAS1-19480; NAG1-1060; NAG1-995; NSF ASC-88-19373; NSF CCR-92-01195; RTOP 505-90-52-01)
(NASA-CR-189729; ICASE-92-60; NAS 1.26:189729) Avail: CASI HC A03/MF A01

We have previously shown that the mathematical technique of uniformization can serve as the basis of synchronization for the parallel simulation of continuous-time Markov chains. This paper reviews the basic method and compares five different methods based on uniformization, evaluating their strengths and weaknesses as a function of problem characteristics. The methods vary in their use of optimism, logical aggregation, communication management, and adaptivity. Performance evaluation is conducted on the Intel Touchstone Delta multiprocessor, using up to 256 processors. Author

N93-16559*# Research Inst. for Computing and Information Systems, Houston, TX.
FUZZY SET METHODS FOR OBJECT RECOGNITION IN SPACE APPLICATIONS Quarterly Report No. 1, 1 Jun. - 30 Sep. 1991

James M. Keller (Missouri Univ., Columbia.) 30 Sep. 1991 39 p
(Contract NCC9-16; RICIS Proj. SE-42)
(NASA-CR-191778; NAS 1.26:191778) Avail: CASI HC A03/MF A01

Progress on the following tasks is reported: (1) fuzzy set-based decision making methodologies; (2) feature calculation; (3) clustering for curve and surface fitting; and (4) acquisition of images. The general structure for networks based on fuzzy set connectives which are being used for information fusion and decision making in space applications is described. The structure and training techniques for such networks consisting of generalized means and gamma-operators are described. The use of other hybrid operators in multicriteria decision making is currently being examined. Numerous classical features on image regions such as gray level statistics, edge and curve primitives, texture measures from cooccurrance matrix, and size and shape parameters were implemented. Several fractal geometric features which may have a considerable impact on characterizing cluttered background, such as clouds, dense star patterns, or some planetary surfaces, were used. A new approach to a fuzzy C-shell algorithm is addressed. NASA personnel are in the process of acquiring suitable simulation data and hopefully videotaped actual shuttle imagery. Photographs have been digitized to use in the algorithms. Also, a model of the shuttle was assembled and a mechanism to orient this model in 3-D to digitize for experiments on pose estimation is being constructed. L.R.R.

N93-16567# Technische Univ., Delft (Netherlands).
DEVELOPMENT OF A COMPUTER ASSISTED TOOLBOX FOR AERODYNAMIC DESIGN OF AIRCRAFT AT SUBCRITICAL CONDITIONS WITH APPLICATION TO THREE-SURFACE AND CANARD AIRCRAFT Ph.D. Thesis
Jan Middel 1992 266 p
(ISBN-90-6275-768-5; ETN-92-92795) Copyright Avail: CASI HC A12/MF A03

The following are considered: the implementation, extension and adaptation of a panel method, important tools used in the aerodynamic monodiscipline, to the conceptual/preliminary design environment, as well as application to the three surace aircraft concept. The tools developed and the application of these tools to the investigation of the three surface aircraft are described. The development of preliminary design systems in general and the Aircraft Design and Analysis System (ADAS) in particular, are considered. The requirements for a numerical aerodynamic toolbox are identified and discussed. The theoretical backgrounds and hence the scope and restrictions concerning the applicability of the ADAS aerodynamic module are discussed. All aerodynamics utilities are built around the NLRAERO program. The capabilities and scope of the original code were increased. The core was adapted to accommodate typical ADAS capabilities such as design optimization and variation. Focus is on drag, lift and pitching moment considerations of a whole series of aircraft, with a not yet fully determined geometry. This required design and implementation of automatic grid generation, more accurate drag and lift analysis as well as implementation of some inverse (optimization, design) capabilities. The three surface aircraft concept as an alternative to the conventional and canard configuration was studied. Aerodynamic trimmed cruise performances were studied for a family of aircraft, through the application of the ADAS Aerodynamic module to both design and off design conditions. ESA

N93-16572# Universiteit Twente, Enschede (Netherlands).
TOWARDS FORMAL SPECIFICATION AND PROOF OF FINITE ELEMENT SOFTWARE WITHIN THE ATES DEVELOPMENT SYSTEMS Ph.D. Thesis
Herman Hendrik tenCate 1991 236 p Sponsored in part by Commission of the European Communities
(ISBN-90-9004337-3; ETN-92-92824) Avail: CASI HC A11/MF A03

The objective of the Advanced Techniques integration into Efficient Scientific (ATES) application software was the construction of a software development system into which three advanced techniques have to be integrated. These techniques are complete abstractions of data types and operators, relational data base programming for macroscopic as well as for microscopic scientific data, and formal specification and proof. The algorithmic language and the specification language of ATES system are presented. The basic concepts, necessary for the verification of the realization of a procedural abstraction and an abstract data type with respect to the formal specification, are explained. The one dimensional heat transfer problem is formally specified and proven within the ATES system. A requirements analysis for the finite element library, and the sofware specification and design of the finite element library are presented. A formal specification of a part of the finite element software library and some charateristic parts of the implementation of the finite element library in the ATES System are described. The necessary actions, which must be carried out to verify a procedural abstraction, and a verification of that procedural abstraction, are presented. Some remarks and a conclusion on the application of software engineering techniques when developing software, on the use of the ATES system as a tool to apply the techniques, and on the use of formal specification and verification are given. ESA

N93-16576# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
COMPUTER AIDED ANALYSIS OF NONLINEAR SYSTEMS
Steve A. Billings and B. R. Haynes (Leeds Univ., England) Jan. 1992 34 p Sponsored in part by Science Research Council
(RR-446; ETN-92-92771) Avail: CASI HC A03/MF A01

The method of analysis applied to any nonlinear system depends to a large extent on the structure of the model representation. The aim of the present work is to achieve the development of an integrated tool for the analysis and probing of nonlinear dynamics within different representations of nonlinear systems. The cell to cell mapping provides a convenient framework for the analysis of both continuous and discrete systems. The development of the suspended all state space system, enabling the analysis of the systems of parameterized bifurcation, was successful. It is shown how a qualitative approach, based around using the parameterized cell map, can provide useful information on periodic characteristics within a system. The importance of parameters such as sampling interval, set point and input excitation, in determining the qualitative characteristics of nonlinear systems is illustrated. Both stability characteristics, periodic behavior and aperiodic behavior can be revealed in the analysis. The qualitative approach allows a broad based coarse probing of nonlinear dynamics and a more detailed analysis around any point of interest. ESA

N93-16579# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
THE COMPUTER AIDED DERIVATION OF LINEARIZED DYNAMICAL MODELS FOR STABILITY ANALYSIS. PART 1: DESCRIPTION OF THE GENERAL MODEL
R. V. Rodenburg Dec. 1990 67 p
(IW-90035-R-Pt-1; ETN-92-92782) Avail: CASI HC A04/MF A01

The path the user has to follow in order to obtain a dynamical model for stability analysis is reported. The general description of the process and how the computer can be used in it are discussed. Examples of this general method are given. The equations of motion were derived on the basis of the Euler approach, the Lagrange equations and the Hamilton approach. The differences between these three approaches are discussed. The means of determining the stability of the system from the equations of motion are investigated. The following possibilities are analyzed: the differential equations are linear and autonomous; the equations are linear but have periodic coefficients; the equations are nonlinear. The linearization of the equations is carried out using Taylor's series expansion, substitution and expansion. The translation of the derivation of the equations into software procedures is explained. ESA

N93-16588# Argonne National Lab., IL.
ADIFOR: A FORTRAN SYSTEM FOR PORTABLE AUTOMATIC DIFFERENTIATION
C. Bischof and A. Griewank 1992 9 p Presented at the 4th AIAA USAF/NASA/OAI Symposium on Multidisciplinary Analysis and Optimization, Cleveland, OH, 21-23 Sep. 1992
(Contract W-31-109-eng-38)
(DE92-040743; ANL/CP-76898; CONF-9209215-1) Avail: CASI HC A02/MF A01

Automatic differentiation provides the foundation for sensitivity analysis and subsequent design optimization of complex systems by reliably computing derivatives of large computer codes, with the potential of doing it many times faster compared to current approaches. The ADIFOR (Automatic DIfferentiation of FORtran) system, a translator that augments Fortran programs with statements for the computation of derivatives, is described. ADIFOR accepts arbitrary Fortran 77 code defining the computation of a function and writes portable Fortran 77 code for the

computation of its derivatives. The goal is to free the computational scientist from worrying about the accurate and efficient computation of derivatives, even for complicated 'functions,' thereby enabling him to concentrate on the more important issues of system modeling and algorithm design. An overview is given of the principles underlying the ADIFOR system, and comments on the power of automatic differentiation for computing derivatives of implicitly-defined functions. DOE

N93-16613*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
USER'S MANUAL FOR INTERACTIVE DATA DISPLAY SYSTEM (IDDS)
James D. Stegeman Nov. 1992 43 p Original contains color illustrations
(RTOP 505-62-52)
(NASA-TM-105572; E-6897; NAS 1.15:105572) Avail: CASI HC A03/MF A01; 5 functional color pages

A computer graphics package for the visualization of three-dimensional flow in turbomachinery has been developed and tested. This graphics package, called IDDS (Interactive Data Display System), is able to 'unwrap' the volumetric data cone associated with a centrifugal compressor and display the results in an easy to understand two-dimensional manner. IDDS will provide the majority of the visualization and analysis capability for the ICE (Integrated CFD and Experiment) system. This document is intended to serve as a user's manual for IDDS in a stand-alone mode. Currently, IDDS is capable of plotting two- or three-dimensional simulation data, but work is under way to expand IDDS so that experimental data can be accepted, plotted, and compared with a simulation dataset of the actual hardware being tested. Author

N93-16620# Ballistic Research Labs., Aberdeen Proving Ground, MD.
INTERACTIVE HYPERBOLIC GRID GENERATION FOR PROJECTILE CFD Final Report, Oct. 1990 - Oct. 1991
Earl N. Ferry, Jr. and Charles J. Nietubicz May 1992 33 p Original contains color illustrations
(DA Proj. 1L1-61102-AH-43)
(BRL-MR-3971) Avail: CASI HC A03/MF A01; 6 functional color pages

The task of grid generation for projectile configurations has previously been performed using non-interactive batch codes. This is not necessarily a trivial task, and as configurations become more complicated, the grid generation process becomes more difficult. In an effort to make this task easier to perform, an existing, non-graphical grid generation code was ported from a VAX 8600 running VMS to an Iris Silicon Graphics work station running Irix. The new code, BRL-PROGRID (projectile grid generation), incorporated interactive graphics to provide ease and flexibility of use while at the same time allowing for many iterations of a grid to be generated. Capabilities gained through the development of the interactive grid generator are described. Examples of grids generated using a modified hyperbolic solver are shown for concave base cavities, and the application of CAD software to the grid generation process is discussed. Author

N93-16642*# Environmental Research Inst. of Michigan, Ann Arbor. Space Automation and Robotics Center.
ROMPS CRITICAL DESIGN REVIEW. VOLUME 2: ROBOT MODULE DESIGN DOCUMENTATION
M. E. Dobbs Dec. 1992 325 p
(Grant NAG5-1517)
(NASA-CR-191614; NAS 1.26:191614; Rept-238800-11-T-Vol-2) Avail: CASI HC A14/MF A03

The robot module design documentation for the Remote Operated Materials Processing in Space (ROMPS) experiment is compiled. This volume presents the following information: robot module modifications; Easylab commands definitions and flowcharts; Easylab program definitions and flowcharts; robot module fault conditions and structure charts; and C-DOC flow structure and cross references. M.G.

N93-16667# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
CONVERSION OF DISCRETE EVENT SIMULATION MODELS TO DIAGNOSTIC MODELS
R. F. Riswick and R. R. Bakker May 1992 35 p Sponsored by Stichting Knowledge Based Systems
(Memo-INF-92-37; UT-KBS-92-22; SKBS-A1/92-12; ETN-92-92449)
Copyright Avail: CASI HC A03/MF A01

The reuse of simulation models is addressed. Model based diagnosis is concerned with identifying defects in technical systems using models of the systems. One of the problems in doing this is modeling. Modeling from scratch is difficult and often infeasible because no expert knowledge on the system is available. The modeling problem is attempted to be avoided by using existing information about the system. Focus is put on the class of discrete event simulation models. By means of a case study, possible approaches to the reuse of simulation models are considered. A method to derive structural and behavioral information from simulation models is described. Using this information, some existing diagnostic methods can be applied. Other methods require extra information. Reuse of simulation models for diagnostic purposes is concluded to be possible, both in theory and in practice. ESA

N93-16668# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
AN ALGORITHM FOR THE CONSTRUCTION OF DEPENDENCY TREES
Gerrit F. vanderHoeven May 1992 33 p
(Memo-INF-92-39; ETN-92-92450) Copyright Avail: CASI HC A03/MF A01

An O(n cubed) algorithm for the construction of dependency trees for sequences of actors, given a casting system, is presented. The algorithm is generalized to an algorithm which constructs analysis trees for sequences of symbols, given a so called FB system. FB systems are formally defined, and it is shown how both context free grammar and casting systems can be represented as FB systems. The generalized algorithm applied to the FB representation of a context free grammar is roughly the bottom up Earley parser. The elimination of various forms of redundancy by adaptations of the algorithm is shown. One adaptation involves the introduction of predict sets. An indication is given, in general terms, for which kinds of structural analysis (besides dependency and context free parsing) the introduced methods are applicable. ESA

N93-16671# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
THE DYNAMICS OF DESCRIPTION
D. Jan N. vanEijck (OTS, Utrecht, Netherlands) Oct. 1991 21 p
(CWI-CS-R9143; ETN-92-92486) Copyright Avail: CASI HC A03/MF A01

In static semantics of natural language, the use of definite and indefinite descriptions encounters certain difficulties. The purpose is to show that these problems can to a large extent be overcome by switching to a dynamic perspective, and to demonstrate how description operators acquire a new lustre and attractiveness in a dynamic setup. A dynamic assignment language with eta and iota assignment in the style of dynamic predicate logic is presented. The constructs for eta and iota assignment allow a straightforward analysis of indefinite and definite descriptions in natural language. It is shown how the standard way of defining the semantics for these leads to a Russellian treatment of definite descriptions. A Hoare style calculus for this system is discussed. It is shown how the Hoare style rules allow the calculation of static truth conditions, or static falsity conditions of dynamic representations structures. The dynamic semantics is enriched with error states, intended to monitor failure of uniqueness presuppositions for definite descriptions. The rules for iota assignment can take the presuppositions of the use of definite descriptions into account, which gets a Strawsonian treatment of definites. It is indicated how a Hoare calculus for the error state semantics might be devised. ESA

N93-16673*# Environmental Research Inst. of Michigan, Ann Arbor. Space Automation and Robotics Center.
ROMPS CRITICAL DESIGN REVIEW. VOLUME 1: HARDWARE
M. E. Dobbs Dec. 1992 257 p
(Grant NAG5-1517)
(NASA-CR-191613; NAS 1.26:191613; Rept-238800-11-T-Vol-1) Avail: CASI HC A12/MF A03

Topics concerning the Robot-Operated Material Processing in Space (ROMPS) Program are presented in viewgraph form and include the following: a systems overview; servocontrol and servomechanisms; testbed and simulation results; system V controller; robot module; furnace module; SCL experiment supervisor; SCL script sample processing control; SCL experiment

supervisor fault handling; block diagrams; hitchhiker interfaces; battery systems; watchdog timers; mechanical/thermal systems; and fault conditions and recovery. Author

N93-16674*# Rensselaer Polytechnic Inst., Troy, NY. Electrical, Computer, and Systems Engineering.

THE M68HC11 GRIPPER CONTROLLER SOFTWARE Thesis

Jodi Wei-Duk Tsai May 1991 71 p

(Grant NAGw-1333)

(NASA-CR-191873; NAS 1.26:191873; CIRSSE-90) Avail: CASI HC A04/MF A01

This thesis discusses the development of firmware for the 68HC11 gripper controller. A general description of the software and hardware interfaces is given. The C library interface for the gripper is then described and followed by a detailed discussion of the software architecture of the firmware. A procedure to assemble and download 68HC11 programs is presented in the form of a tutorial. The tools used to implement this environment are then described. Finally, the implementation of the configuration management scheme used to manage all CIRSSE software is presented. Author

N93-16678*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.

MODEL BASED ESTIMATION OF IMAGE DEPTH AND DISPLACEMENT

Kevin T. Damour May 1992 141 p

(Grant NAGw-1333)

(NASA-CR-191815; NAS 1.26:191815; CIRSSE-113) Avail: CASI HC A07/MF A02

Passive depth and displacement map determinations have become an important part of computer vision processing. Applications that make use of this type of information include autonomous navigation, robotic assembly, image sequence compression, structure identification, and 3-D motion estimation. With the reliance of such systems on visual image characteristics, a need to overcome image degradations, such as random image-capture noise, motion, and quantization effects, is clearly necessary. Many depth and displacement estimation algorithms also introduce additional distortions due to the gradient operations performed on the noisy intensity images. These degradations can limit the accuracy and reliability of the displacement or depth information extracted from such sequences. Recognizing the previously stated conditions, a new method to model and estimate a restored depth or displacement field is presented. Once a model has been established, the field can be filtered using currently established multidimensional algorithms. In particular, the reduced order model Kalman filter (ROMKF), which has been shown to be an effective tool in the reduction of image intensity distortions, was applied to the computed displacement fields. Results of the application of this model show significant improvements on the restored field. Previous attempts at restoring the depth or displacement fields assumed homogeneous characteristics which resulted in the smoothing of discontinuities. In these situations, edges were lost. An adaptive model parameter selection method is provided that maintains sharp edge boundaries in the restored field. This has been successfully applied to images representative of robotic scenarios. In order to accommodate image sequences, the standard 2-D ROMKF model is extended into 3-D by the incorporation of a deterministic component based on previously restored fields. The inclusion of past depth and displacement fields allows a means of incorporating the temporal information into the restoration process. A summary on the conditions that indicate which type of filtering should be applied to a field is provided. Author

N93-16681*# Institute for Computer Applications in Science and Engineering, Hampton, VA.

A GENERAL PURPOSE SUBROUTINE FOR FAST FOURIER TRANSFORM ON A DISTRIBUTED MEMORY PARALLEL MACHINE

A. Dubey (Old Dominion Univ., Norfolk, VA.), M. Zubair (Old Dominion Univ., Norfolk, VA.), and C. E. Grosch (Old Dominion Univ., Norfolk, VA.) Nov. 1992 15 p

(Contracts NAS1-18605; NAS1-19480; RTOP 505-90-52-01)

(NASA-CR-189724; NAS 1.26:189724; ICASE-92-56) Avail: CASI HC A03/MF A01

One issue which is central in developing a general purpose Fast Fourier Transform (FFT) subroutine on a distributed memory parallel machine is the data distribution. It is possible that different users would like to use the FFT routine with different data distributions. Thus, there is a need to design FFT schemes on distributed memory parallel machines which can support a variety of data distributions. An FFT implementation on a distributed memory parallel machine which works for a number of data distributions commonly encountered in scientific applications is presented. The problem of rearranging the data after computing the FFT is also addressed. The performance of the implementation on a distributed memory parallel machine Intel iPSC/860 is evaluated. Author

N93-16684*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

INCREASINGLY AUTOMATED PROCEDURE ACQUISITION IN DYNAMIC SYSTEMS

Nathalie Mathe and Smadar Kedar (Sterling Federal Systems, Inc., Moffett Field, CA.) Jun. 1992 20 p Presented at the 7th Banff Knowledge Acquisition for Knowledge Based Systems Workshop, Banff, Canada, 11-16 Oct. 1992

(NASA-TM-108112; FIA-92-23; NAS 1.15:108112) Avail: CASI HC A03/MF A01

Procedures are widely used by operators for controlling complex dynamic systems. Currently, most development of such procedures is done manually, consuming a large amount of paper, time, and manpower in the process. While automated knowledge acquisition is an active field of research, not much attention has been paid to the problem of computer-assisted acquisition and refinement of complex procedures for dynamic systems. The Procedure Acquisition for Reactive Control Assistant (PARC), which is designed to assist users in more systematically and automatically encoding and refining complex procedures. PARC is able to elicit knowledge interactively from the user during operation of the dynamic system. We categorize procedure refinement into two stages: diagnosis - diagnose the failure and choose a repair - and repair - plan and perform the repair. The basic approach taken in PARC is to assist the user in all steps of this process by providing increased levels of assistance with layered tools. We illustrate the operation of PARC in refining procedures for the control of a robot arm. Author

N93-16723*# California Univ., Los Angeles.

RELIABLE AND EFFICIENT PARALLEL PROCESSING ALGORITHMS AND ARCHITECTURES FOR MODERN SIGNAL PROCESSING Ph.D. Thesis

KuoJuey Ray Liu 1990 174 p

(Contract NCC2-374; NAG2-374; NSF NCR-88-14407)

(NASA-CR-191969; NAS 1.26:191969) Copyright Avail: CASI HC A08/MF A02

Least-squares (LS) estimations and spectral decomposition algorithms constitute the heart of modern signal processing and communication problems. Implementations of recursive LS and spectral decomposition algorithms onto parallel processing architectures such as systolic arrays with efficient fault-tolerant schemes are the major concerns of this dissertation. There are four major results in this dissertation. First, we propose the systolic block Householder transformation with application to the recursive least-squares minimization. It is successfully implemented on a systolic array with a two-level pipelined implementation at the vector level as well as at the word level. Second, a real-time algorithm-based concurrent error detection scheme based on the residual method is proposed for the QRD RLS systolic array. The fault diagnosis, order degraded reconfiguration, and performance analysis are also considered. Third, the dynamic range, stability, error detection capability under finite-precision implementation, order degraded performance, and residual estimation under faulty situations for the QRD RLS systolic array are studied in details. Finally, we propose the use of multi-phase systolic algorithms for spectral decomposition based on the QR algorithm. Two systolic architectures, one based on triangular array and another based on rectangular array, are presented for the multiphase operations with fault-tolerant considerations. Eigenvectors and singular vectors can be easily obtained by using the multi-pase operations. Performance issues are also considered. Author

N93-16725*# Rensselaer Polytechnic Inst., Troy, NY. Electrical, Computer, and Systems Engineering.

TOKENPASSER: A PETRI NET SPECIFICATION TOOL Thesis

Michael Mittmann Jan. 1991 167 p

(Grant NAGw-1333)

(NASA-CR-191816; NAS 1.26:191816; CIRSSE-81) Avail: CASI HC A08/MF A02

In computer program design it is essential to know the effectiveness of different design options in improving performance, and dependability. This paper provides a description of a CAD tool for distributed hierarchical Petri nets. After a brief review of Petri nets, Petri net languages, and Petri net transducers, and descriptions of several current Petri net tools, the specifications and design of the TokenPasser tool are presented. TokenPasser is a tool to allow design of distributed hierarchical systems based on Petri nets. A case study for an intelligent robotic system is conducted, a coordination structure with one dispatcher controlling three coordinators is built to model a proposed robotic assembly system. The system is implemented using TokenPasser, and the results are analyzed to allow judgment of the tool. Author

N93-16732# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.

QUANTIFICATION AND PARTIALITY

D. Jan N. vanEijck (OTS, Utrecht, Netherlands) Dec. 1991 38 p (CWI-CS-R9152; ETN-92-92493) Copyright Avail: CASI HC A03/MF A01

The behavior of binary quantifiers in settings of incomplete information, that is in partial models, is investigated. Quantification can involve partiality in several ways. Quantifiers loaded with presuppositions give rise to partiality by introducing truth value gaps. The study of quantifiers in contexts of incomplete information involves a quite different kind of partiality. The framework to handle the presented informational partiality is relevant to the behavior of quantifiers in the natural language semantics of propositional attitudes and perception reports, to theories of vagueness in natural language, and to semantic accounts of natural language fragments containing a truth predicate. The constraints in binary relations in a universe that make these relations qualify for the honorific title 'quantificational' are generalized to the partial case. Special consideration is given to quantifiers defined via superevaluation from quantifiers in total models. Properties of partial quantifiers are studied, with particular emphasis on behavior under growth of information and growth of domain. ESA

N93-16736 Tel-Aviv Univ. (Israel). Dept. of Computer Science.

CRUISE: CREATIVE USER INTERFACE FOR SOFTWARE ENGINEERING M.S. Thesis

Aviv Cohen Mar. 1990 73 p (ITN-93-85172) Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

This thesis presents CRUISE, the graphic user interface of OBSERV. OBSERV is a methodology that aims to allow a rapid construction of an executable specification (or prototype), to support testing of the prototype by simulation, to facilitate smooth transition to a target system, and to provide means for reusing specification, design and code. CRUISE provides OBSERV with graphic editing capabilities that replace the existing textual editor. The design of CRUISE is a case study in the design of a user interface for a complex application, namely OBSERV. For CRUISE development, emphasis was placed on two distinct yet interrelated goals. One is to develop a Ågood' user interface, whereas the other conforms to the basic concepts of OBSERV - the underlying methodology. We address here the issue of what a good user interface is, outline the objectives we set for CRUISE, present its structure and discuss implementation details and future trends. Author (ISA)

N93-16739 Tel-Aviv Univ. (Israel). Dept. of Electronic Systems.

DISPLAYING A COLOR PICTURE USING A SMALL NUMBER OF COLORS M.S. Thesis

Daniel Seidner Apr. 1990 171 p In HEBREW (ITN-93-85175) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

Use of the usual red-green-blue (RGB) 8-bit data provides a palette of 16,777,216 colors, most of which are not used on a 512x512-pixel screen. Memory volume can be saved and high-speed color processing facilitated by using a representative palette of 256 colors, with a look-up table (LUT) to translate the color number to the desired RGB values. The process of choosing the best colors is treated as a vector quantization problem and the use of an iterative algorithm requires the initial selection of the representative colors. Several algorithms for selecting an initial list of representative colors are presented. The Median Cut algorithm was applied recursively to a three-dimensional RGB histogram of the picture, to find 2 to the power n colors, each representing an equal number of pixels in the picture. The algorithm was developed to enable cuts other than the median to be used and tests were conducted on a set of four pictures in different quantization resolutions. The improved Median Cut algorithm was applied for initial codebook selection in RGB and two other color spaces. Subjective tests indicated the RGB color space to be the best, and it was used in the next step of weighting the histogram to compensate for spatial visual masking. ISA

N93-16741# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.

COUNTEREXAMPLES TO COMPLETENESS RESULTS FOR BASIC NARROWING

Aart Middeldorp and Erik Hamoen (Vrije Univ., Amsterdam, Netherlands) Dec. 1991 47 p Sponsored in part by EEC (CWI-CS-R9154; ETN-92-92495) Copyright Avail: CASI HC A03/MF A01

Completeness results for basic narrowing are analyzed. Basic narrowing is shown to be not complete with respect to normalizable solutions for equational theories defined by confluent term rewriting systems, contrary to conjecture. By imposing syntactic restrictions on the rewrite rules, completeness is recovered. A result of Hoelldobler states that the completeness of basic conditional narrowing for complete (confluent and terminating) conditional term rewriting systems without extra variables in the conditions of the rewrite rules is refuted. The completeness result of Giovanetti and Moiso for level confluent and terminating conditional systems with extra variables in the conditions is extended to systems that may also have extra variables in the right hand sides of the rules. ESA

N93-16750*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

TRADEOFFS IN THE UTILITY OF LEARNED KNOWLEDGE

Smadar Kedar (Sterling Software, Moffett Field, CA.) and Kathleen B. McKusick (Sterling Software, Moffett Field, CA.) Jun. 1992 3 p (NASA-TM-108111; FIA-92-22; NAS 1.15:108111) Avail: CASI HC A01/MF A01

Planning systems which make use of domain theories can produce more accurate plans and achieve more goals as the quality of their domain knowledge improves. MTR, a multi-strategy learning system, was designed to learn from system failures and improve domain knowledge used in planning. However, augmented domain knowledge can decrease planning efficiency. We describe how improved knowledge that becomes expensive to use can be approximated to yield calculated tradeoffs in accuracy and efficiency. Author

N93-16846# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

A LINEAR TIME ALGORITHM FOR RECOGNIZING INTERVAL ORDERS

Renate Garbe Mar. 1992 10 p (MEMO-1046; ETN-92-92473) Avail: CASI HC A02/MF A01

A problem concerning the finding of a linear algorithm, given an arbitrary graph, which decides whether it belongs to a special class of graphs, is addressed. A linear time algorithm that decides whether the transitive closure of a given directed acyclic graph is an interval order, and, if it is, simultaneously computes its transitive reduction, is presented. ESA

N93-16853# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.

GENERALIZED LR PARSING FOR GENERAL CONTEXT-FREE GRAMMARS

J. Rekers Dec. 1991 34 p Sponsored in part by EEC, and Netherlands Organization for Scientific Research (CWI-CS-R9153; ETN-92-92494) Copyright Avail: CASI HC A03/MF A01

The question of which methods for parser generation and parsing are best suited for an interactive development system of syntax definitions is addressed. A Generalized LR (GLR) parsing algorithm is argued to be the best choice. An enhanced version of Tomita's GLR algorithm is presented and its efficiency is compared with two competitors, YACC and Earley's algorithm. ESA

N93-16933*# Gallaudet Coll., Washington, DC. Dept. of Physics.
MONTE CARLO SHOWER COUNTER STUDIES Progress Report
H. David Snyder 1991 155 p
(Grant NAG5-1812)
(NASA-CR-191364; NAS 1.26:191364) Avail: CASI HC A08/MF A02

Activities and accomplishments related to the Monte Carlo shower counter studies are summarized. A tape of the VMS version of the GEANT software was obtained and installed on the central computer at Gallaudet University. Due to difficulties encountered in updating this VMS version, a decision was made to switch to the UNIX version of the package. This version was installed and used to generate the set of data files currently accessed by various analysis programs. The GEANT software was used to write files of data for positron and proton showers. Showers were simulated for a detector consisting of 50 alternating layers of lead and scintillator. Each file consisted of 1000 events at each of the following energies: 0.1, 0.5, 2.0, 10, 44, and 200 GeV. Data analysis activities related to clustering, chi square, and likelihood analyses are summarized. Source code for the GEANT user subprograms and data analysis programs are provided along with example data plots. M.G.

N93-16987# Sandia National Labs., Albuquerque, NM.
VERIFICATION OF THE COMPUTER PROGRAMS SLAAP AND DATA
J. L. Cawlfield and E. L. Smith Oct. 1992 48 p
(Contract DE-AC04-76DP-00789)
(DE93-002597; SAND-92-0508) Avail: CASI HC A03/MF A01

The computer programs SLAAP and DATA are currently being used by Division 2743 for data analysis. These programs had not been previously verified to determine if they were producing correct results. The objective was to verify these programs by comparing their results to those obtained with GRAFAID, a verified data analysis program. To accomplish this, five acceleration-time histories were selected. For each time history, the shock response spectrum, integral, double integral, derivative, and Fourier transform were computed using SLAAP, DATA, and GRAFAID. The results of each operation for each time history were overlay plotted for comparison. The results show only minor differences in some cases. These differences are deterministic and are due to differences in the algorithms or block size restrictions of the three programs. DOE

N93-16998# Rome Univ. (Italy). Dipt. di Fisica.
DYNAMIC PARSERS, EVOLVING GRAMMARS AND INCREMENTAL LANGUAGES
S. Cabasino (Istituto Nazionale di Fisica Nucleare, Rome, Italy), P. S. Paolucci (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and G. M. Todesco (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 8 Jan. 1992 16 p
(Preprint-863; ETN-93-92965) Avail: CASI HC A03/MF A01

Dynamic parsers are defined as parsers able to follow the incremental evolution of a context grammar during the parsing phase. Some innovative theoretical and practical results in the field of formal language theory and compiler design are reported. The core of the idea is the introduction of dynamics in grammar theory, that is grammars changing in time, as opposed to the conventional static grammars. This approach is useful to solve a class of typical problems in programming language definition and compiler design. A dynamic parser, developed and successfully employed to produce a major incremental programming language and the system software tools for the 100 GigaFlops SIMD parallel machine under development, is considered. ESA

N93-17040# Oak Ridge National Lab., TN.
EXPLORATORY DESIGNS FOR COMPUTATIONAL EXPERIMENTS
M. X. Morris and T. J. Mitchell Oct. 1992 39 p
(Contract DE-AC05-84OR-21400)
(DE93-002354; ORNL/TM-12045) Avail: CASI HC A03/MF A01

Recent work by Johnson, Moore and Ylvisaker (1990) establishes equivalence of the maximin distance design criterion and an entropy criterion motivated by function prediction in a Bayesian setting. The latter criterion has been used by Currin, Mitchell, Morris, and Ylvisaker (1991) to design experiments for which the motivating application is approximation of a complex deterministic computer model. Because computer experiments often have a large number of controlled variables (inputs), maximin designs of moderate size are often concentrated in the corners of the cuboidal design region, i.e., each input is represented at only two levels. Here we will examine some maximin distance designs constructed within the class of Latin hypercube arrangements. The goal of this is to find designs which offer a compromise between the entropy/maximin criterion, and good projective properties in each dimension (as guaranteed by Latin hypercubes). A simulated annealing search algorithm is persented for constructing these designs, and patterns apparent in the optimal designs are discussed. DOE

N93-17063# Sandia National Labs., Albuquerque, NM.
CONSTITUTIVE AND EQUATION OF STATE MODELS USING OBJECT-ORIENTED PROGRAMMING METHODS
M. K. W. Wong, J. S. Peery, and K. G. Budge 1992 12 p Presented at the Society of Engineering Science Technical Meeting, San Diego, CA, 14-16 Sep. 1992
(Contract DE-AC04-76DP-00789)
(DE93-000740; SAND-92-0866C; CONF-9209240-1) Avail: CASI HC A03/MF A01

Large-scale simulations of solid dynamics problems require sophisticated computer hardware, employing specialized or unique features to enhance performance. The developer of computational mechanics codes is not only faced with the task of programming the necessary analysis algorithms, but also of ensuring that the available system capabilities are properly utilized to obtain the highest possible performance. Developing and maintaining the code for a number of computers, ranging from single processor serial workstations to massively parallel vectorized supercomputers, becomes a very difficult, potentially intractable problem. In this paper, we present an approach that seeks to minimize this problem by applying object-oriented programming (OOP) concepts to the development of the RHALE++ hydrodynamics/solid mechanics code that is written in the C++ language. In particular, we use the OOP paradigm to facilitate code development, maintenance, and portability of constitutive and equation of state models. DOE

N93-17161*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COLLECTED SOFTWARE ENGINEERING PAPERS, VOLUME 10
Nov. 1992 164 p
(NASA-TM-108581; SEL-92-003-Vol-10; NAS 1.15:108581) Avail: CASI HC A08/MF A02

This document is a collection of selected technical papers produced by participants in the Software Engineering Laboratory (SEL) from Oct. 1991 - Nov. 1992. The purpose of the document is to make available, in one reference, some results of SEL research that originally appeared in a number of different forums. Although these papers cover several topics related to software engineering, they do not encompass the entire scope of SEL activities and interests. Additional information about the SEL and its research efforts may be obtained from the sources listed in the bibliography at the end of this document. For the convenience of this presentation, the 11 papers contained here are grouped into 5 major sections: (1) the Software Engineering Laboratory; (2) software tools studies; (3) software models studies; (4) software measurement studies; and (5) Ada technology studies. For individual titles, see N93-17162 through N93-17172.

N93-17162*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE SOFTWARE ENGINEERING LABORATORY: AN OPERATIONAL SOFTWARE EXPERIENCE FACTORY
Victor R. Basili (Maryland Univ., College Park.), Gianluigi Caldiera (Maryland Univ., College Park.), Frank McGarry, Rose Pajerski, Gerald Page (Computer Sciences Corp., Greenbelt, MD.), and Sharon Waligora (Computer Sciences Corp., Greenbelt, MD.) *In its* Collected Software Engineering Papers, Volume 10 Nov. 1992 12 p (For primary document see N93-17161 05-61)
Avail: CASI HC A03/MF A02

For 15 years, the Software Engineering Laboratory (SEL) has been carrying out studies and experiments for the purpose of understanding, assessing, and improving software and software processes within a production software development environment at NASA/GSFC. The SEL comprises three major organizations: (1) NASA/GSFC, Flight Dynamics Division; (2) University of Maryland, Department of Computer Science; and (3) Computer Sciences Corporation, Flight Dynamics Technology Group.

These organizations have jointly carried out several hundred software studies, producing hundreds of reports, papers, and documents, all of which describe some aspect of the software engineering technology that was analyzed in the flight dynamics environment at NASA. The studies range from small, controlled experiments (such as analyzing the effectiveness of code reading versus that of functional testing) to large, multiple project studies (such as assessing the impacts of Ada on a production environment). The organization's driving goal is to improve the software process continually, so that sustained improvement may be observed in the resulting products. This paper discusses the SEL as a functioning example of an operational software experience factory and summarizes the characteristics of and major lessons learned from 15 years of SEL operations. Author

N93-17163*# Maryland Univ., College Park. Inst. for Advanced Computer Studies.

TOWARDS AUTOMATED SUPPORT FOR EXTRACTION OF REUSABLE COMPONENTS

S. K. Abd-El-Hafiz, Victor R. Basili, and Gianluigi Caldiera *In* NASA. Goddard Space Flight Center, Collected Software Engineering Papers, Volume 10 Nov. 1992 8 p (For primary document see N93-17161 05-61)

(Contract NsG-5123; N00014-87-C-0307)

Avail: CASI HC A02/MF A02

A cost effective introduction of software reuse techniques requires the reuse of existing software developed in many cases without aiming at reusability. This paper discusses the problems related to the analysis and reengineering of existing software in order to reuse it. We introduce a process model for component extraction and focus on the problem of analyzing and qualifying software components which are candidates for reuse. A prototype tool for supporting the extraction of reusable components is presented. One of the components of this tool aids in understanding programs and is based on the functional model of correctness. It can assist software engineers in the process of finding correct formal specifications for programs. A detailed description of this component and an example to demonstrate a possible operational scenario are given. Author

N93-17164*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

AUTOMATED SUPPORT FOR EXPERIENCE-BASED SOFTWARE MANAGEMENT

Jon D. Valett *In its* Collected Software Engineering Papers, Volume 10 Nov. 1992 19 p (For primary document see N93-17161 05-61)

Avail: CASI HC A03/MF A02

To effectively manage a software development project, the software manager must have access to key information concerning a project's status. This information includes not only data relating to the project of interest, but also, the experience of past development efforts within the environment. This paper describes the concepts and functionality of a software management tool designed to provide this information. This tool, called the Software Management Environment (SME), enables the software manager to compare an ongoing development effort with previous efforts and with models of the 'typical' project within the environment, to predict future project status, to analyze a project's strengths and weaknesses, and to assess the project's quality. In order to provide these functions the tool utilizes a vast corporate memory that includes a data base of software metrics, a set of models and relationships that describe the software development environment, and a set of rules that capture other knowledge and experience of software managers within the environment. Integrating these major concepts into one software management tool, the SME is a model of the type of management tool needed for all software development organizations. Author

N93-17165*# Maryland Univ., College Park. Dept. of Computer Science.

THE SOFTWARE-CYCLE MODEL FOR RE-ENGINEERING AND REUSE

John W. Bailey and Victor R. Basili *In* NASA. Goddard Space Flight Center, Collected Software Engineering Papers, Volume 10 Nov. 1992 15 p (For primary document see N93-17161 05-61)

Avail: CASI HC A03/MF A02

This paper reports on the progress of a study which will contribute to our ability to perform high-level, component-based programming by describing means to obtain useful components, methods for the configuration and integration of those components, and an underlying economic model of the costs and benefits associated with this approach to reuse. One goal of the study is to develop and demonstrate methods to recover reusable components from domain-specific software through a combination of tools, to perform the identification, extraction, and re-engineering of components, and domain experts, to direct the applications of those tools. A second goal of the study is to enable the reuse of those components by identifying techniques for configuring and recombining the re-engineered software. This component-recovery or software-cycle model addresses not only the selection and re-engineering of components, but also their recombination into new programs. Once a model of reuse activities has been developed, the quantification of the costs and benefits of various reuse options will enable the development of an adaptable economic model of reuse, which is the principal goal of the overall study. This paper reports on the conception of the software-cycle model and on several supporting techniques of software recovery, measurement, and reuse which will lead to the development of the desired economic model. Author

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ON THE NATURE OF BIAS AND DEFECTS IN THE SOFTWARE SPECIFICATION PROCESS

Pablo A. Straub and Marvin V. Zelkowitz (Maryland Univ., College Park.) *In* NASA. Goddard Space Flight Center, Collected Software Engineering Papers, Volume 10 Nov. 1992 8 p (For primary document see N93-17161 05-61)

(Grant NsG-5123)

Avail: CASI HC A02/MF A02

Implementation bias in a specification is an arbitrary constraint in the solution space. This paper describes the problem of bias. Additionally, this paper presents a model of the specification and design processes describing individual subprocesses in terms of precision/detail diagrams and a model of bias in multi-attribute software specifications. While studying how bias is introduced into a specification we realized that software defects and bias are dual problems of a single phenomenon. This was used to explain the large proportion of faults found during the coding phase at the Software Engineering Laboratory at NASA/GSFC. Author

N93-17167*# IBM Canada Lab., North York (Ontario). Software Engineering Process Group.

AN IMPROVED CLASSIFICATION TREE ANALYSIS OF HIGH COST MODULES BASED UPON AN AXIOMATIC DEFINITION OF COMPLEXITY

Jianhui Tian, Adam Porter (Maryland Univ., College Park.), and Marvin V. Zelkowitz (Maryland Univ., College Park.) *In* NASA. Goddard Space Flight Center, Collected Software Engineering Papers, Volume 10 Nov. 1992 9 p (For primary document see N93-17161 05-61)

(Grants NsG-5123; NSF CCR-88-19793)

Avail: CASI HC A02/MF A02

Identification of high cost modules has been viewed as one mechanism to improve overall system reliability, since such modules tend to produce more than their share of problems. A decision tree model was used to identify such modules. In this current paper, a previously developed axiomatic model of program complexity is merged with the previously developed decision tree process for an improvement in the ability to identify such modules. This improvement was tested using data from the NASA Software Engineering Laboratory. Author

N93-17168*# Maryland Univ., College Park. Inst. for Advanced Computer Studies.

PROVIDING AN EMPIRICAL BASIS FOR OPTIMIZING THE VERIFICATION AND TESTING PHASES OF SOFTWARE DEVELOPMENT

Lionel C. Briand, Victor R. Basili, and Christopher J. Hetmanski *In* NASA. Goddard Space Flight Center, Collected Software Engineering Papers, Volume 10 Nov. 1992 12 p Submitted for publication (For primary document see N93-17161 05-61)

(Grants NsG-5123; AF-AFOSR-0031-90)

Avail: CASI HC A03/MF A02

Applying equal testing and verification effort to all parts of a software system is not very efficient, especially when resources are limited and scheduling is tight. Therefore, one needs to be able to differentiate low/high

fault density components so that the testing/verification effort can be concentrated where needed. Such a strategy is expected to detect more faults and thus improve the resulting reliability of the overall system. This paper presents an alternative approach for constructing such models that is intended to fulfill specific software engineering needs (i.e. dealing with partial/incomplete information and creating models that are easy to interpret). Our approach to classification is as follows: (1) to measure the software system to be considered; and (2) to build multivariate stochastic models for prediction. We present experimental results obtained by classifying FORTRAN components developed at the NASA/GSFC into two fault density classes: low and high. Also we evaluate the accuracy of the model and the insights it provides into the software process. Author

N93-17169*# Maryland Univ., College Park. Inst. for Advanced Computer Studies.

A CLASSIFICATION PROCEDURE FOR THE EFFECTIVE MANAGEMENT OF CHANGES DURING THE MAINTENANCE PROCESS

Lionel C. Briand and Victor R. Basili *In* NASA. Goddard Space Flight Center, Collected Software Engineering Papers, Volume 10 Nov. 1992 12 p Sponsored in cooperation with Vitro Corp. Submitted for publication (For primary document see N93-17161 05-61)
(Grant NsG-5123)
Avail: CASI HC A03/MF A02

During software operation, maintainers are often faced with numerous change requests. Given available resources such as effort and calendar time, changes, if approved, have to be planned to fit within budget and schedule constraints. In this paper, we address the issue of assessing the difficulty of a change based on known or predictable data. This paper should be considered as a first step towards the construction of customized economic models for maintainers. In it, we propose a modeling approach, based on regular statistical techniques, that can be used in a variety of software maintenance environments. The approach can be easily automated, and is simple for people with limited statistical experience to use. Moreover, it deals effectively with the uncertainty usually associated with both model inputs and outputs. The modeling approach is validated on a data set provided by NASA/GSFC which shows it was effective in classifying changes with respect to the effort involved in implementing them. Other advantages of the approach are discussed along with additional steps to improve the results. Author

N93-17170*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

TOWARD FULL LIFE CYCLE CONTROL: ADDING MAINTENANCE MEASUREMENT TO THE SEL

H. Dieter Rombach (Maryland Univ., College Park.), Bradford T. Ulery (Maryland Univ., College Park.), and Jon D. Valett *In its* Collected Software Engineering Papers, Volume 10 Nov. 1992 14 p Repr. from Journal of Systems Software, v. 18, 1992 p 125-138 (For primary document see N93-17161 05-61)
(Grant NsG-5123)
Avail: CASI HC A03/MF A02

Organization-wide measurement of software products and processes is needed to establish full life cycle control over software products. The Software Engineering Laboratory (SEL)--a joint venture between NASA GSFC, the University of Maryland, and Computer Sciences Corporation--started measurement of software development more than 15 years ago. Recently, the measurement of maintenance was added to the scope of the SEL. In this article, the maintenance measurement program is presented as an addition to the already existing and well-established SEL development measurement program and evaluated in terms of its immediate benefits and long-term improvement potential. Immediate benefits of this program for the SEL include an increased understanding of the maintenance domain, the differences and commonalities between development and maintenance, and the cause-effect relationships between development and maintenance. Initial results from a sample maintenance study are presented to substantiate these benefits. The long-term potential of this program includes the use of maintenance baselines to better plan and manage future projects and to improve development and maintenance practices for future projects wherever warranted. Author

N93-17171*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

OBJECT-ORIENTED PROGRAMMING WITH MIXINS IN ADA

Ed Seidewitz *In its* Collected Software Engineering Papers, Volume 10 Nov. 1992 15 p (For primary document see N93-17161 05-61)
Avail: CASI HC A03/MF A02

Recently, I wrote a paper discussing the lack of 'true' object-oriented programming language features in Ada 83, why one might desire them in Ada, and how they might be added in Ada 9X. The approach I took in this paper was to build the new object-oriented features of Ada 9X as much as possible on the basic constructs and philosophy of Ada 83. The object-oriented features proposed for Ada 9X, while different in detail, are based on the same kind of approach. Further consideration of this approach led me on a long reflection on the nature of object-oriented programming and its application to Ada. The results of this reflection, presented in this paper, show how a fairly natural object-oriented style can indeed be developed even in Ada 83. The exercise of developing this style is useful for at least three reasons: (1) it provides a useful style for programming object-oriented applications in Ada 83 until new features become available with Ada 9X; (2) it demystifies many of the mechanisms that seem to be 'magic' in most object-oriented programming languages by making them explicit; and (3) it points out areas that are and are not in need of change in Ada 83 to make object-oriented programming more natural in Ada 9X. In the next four sections I will address in turn the issues of object-oriented classes, mixins, self-reference and supertyping. The presentation is through a sequence of examples. This results in some overlap with that paper, but all the examples in the present paper are written entirely in Ada 83. I will return to considerations for Ada 9X in the last section of the paper. Author

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SOFTWARE ENGINEERING LABORATORY ADA PERFORMANCE STUDY: RESULTS AND IMPLICATIONS

Eric W. Booth (Computer Sciences Corp., Lanham, MD.) and Michael E. Stark *In its* Collected Software Engineering Papers, Volume 10 Nov. 1992 9 p (For primary document see N93-17161 05-61)
Avail: CASI HC A02/MF A02

The SEL is an organization sponsored by NASA/GSFC to investigate the effectiveness of software engineering technologies applied to the development of applications software. The SEL was created in 1977 and has three organizational members: NASA/GSFC, Systems Development Branch; The University of Maryland, Computer Sciences Department; and Computer Sciences Corporation, Systems Development Operation. The goals of the SEL are as follows: (1) to understand the software development process in the GSFC environments; (2) to measure the effect of various methodologies, tools, and models on this process; and (3) to identify and then to apply successful development practices. The activities, findings, and recommendations of the SEL are recorded in the Software Engineering Laboratory Series, a continuing series of reports that include the Ada Performance Study Report. This paper describes the background of Ada in the Flight Dynamics Division (FDD), the objectives and scope of the Ada Performance Study, the measurement approach used, the performance tests performed, the major test results, and the implications for future FDD Ada development efforts. Author

N93-17360# California Univ., Berkeley. Lawrence Berkeley Lab.

MONTE CARLO SIMULATIONS ON SIMD COMPUTER ARCHITECTURES

C. P. Burmester, R. Gronsky, and L. T. Wille (Florida Atlantic Univ., Boca Raton.) Mar. 1992 7 p Presented at the 1992 Material Research Society Spring Meeting, San Francisco, CA, 27 Apr. - 2 May 1992
(Contract DE-AC03-76SF-00098)
(DE92-041210; LBL-32512; CONF-920402-60) Avail: CASI HC A02/MF A01

Algorithmic considerations regarding the implementation of various materials science applications of the Monte Carlo technique to single instruction multiple data (SMM) computer architectures are presented. In particular, implementation of the Ising model with nearest, next nearest, and long range screened Coulomb interactions on the SIMD architecture MasPar MP-1 (DEC mpp-12000) series of massively parallel computers is demonstrated. Methods of code development which optimize processor

array use and minimize inter-processor communication are presented including lattice partitioning and the use of processor array spanning tree structures for data reduction. Both geometric and algorithmic parallel approaches are utilized. Benchmarks in terms of Monte Carlo updates per second for the MasPar architecture are presented and compared to values reported in the literature from comparable studies on other architectures. DOE

N93-17477# Lawrence Livermore National Lab., CA.
COMPLEXITY OPTIMIZED VECTOR QUANTIZATION: A NEURAL NETWORK APPROACH
J. Buhmann and H. Kuehnel 31 Jan. 1992 12 p Presented at the Data Compression Conference, Snowbird, UT, 24-26 Mar. 1992
(Contract W-7405-eng-48)
(DE93-001304; UCRL-JC-109361; CONF-9203200-1) Avail: CASI HC A03/MF A01

A vector quantization strategy which jointly optimizes distortion errors and complexity costs is discussed. A maximum entropy estimation of the vector quantization cost function yields an optimal codebook size, the reference vectors, and the assignment frequencies. We compare different complexity measures for the design of image compression algorithms which quantize wavelet decomposed images. An online version of complexity optimized vector quantization is implemented by an artificial neural network with winner-take-all connectivity. Our approach establishes unifying framework for different quantization methods like K-means clustering and its fuzzy version, entropy constrainted vector quantization or self-organizing topological maps and competitive neural networks. DOE

N93-17484# EG and G Energy Measurements, Inc., Idaho Falls.
IMAGING SYSTEM (INEL) DEVELOPMENT SOFTWARE EVALUATION
J. K. Partin, G. D. Lassahn, and J. R. Davidson Sep. 1992 25 p
(Contract DE-AC07-76ID-01570)
(DE93-001940; EGG-PHY-10394) Avail: CASI HC A03/MF A01

This report gives a description and an evaluation of the software used during the developmental phase of a project to design and produce an automatic target recognition system. The purpose of the Imaging System Project is to develop a reconnaissance system that can be attached to and carried aloft by any of several aircraft. This system will include several imaging sensors, among them a visible light camera, an infrared imaging system, and a radar imaging system. Each scene of interest will be photographed by each sensor, so we will have several different images of each scene. The several images will be analyzed by a computer to determine the presence of previously specified objects of interest in the scene. The EG&G Idaho (INEL) part of the overall project is the development of the image analysis computer, an automatic target recognition (ATR) system. This task includes choosing and assembling the computer hardware, developing the ATR algorithms, and developing software to implement the algorithms on the selected hardware. Special requirements for this ATR system include image fusion and uncertainty estimation. Image fusion means that the ATR system must analyze the three images jointly to produce a single, high confidence statement of the presence of a target, as opposed to analyzing the three images separately and producing three separate, lower-confidence, possibly contradictory, indications of the presence of targets. Uncertainty estimation means that the ATR system must tell the user what confidence the user should have in the ATR system's report of the presence or absence of targets. In addition, there are the common requirements for speed, portability, and low cost of the ATR system. We have completed a fully functional developmental version of the ATR system. This is a laboratory system, not suitable for field deployment. Future work will make the system easily usable in field applications. DOE

N93-17490# Technische Univ., Delft (Netherlands). Manufacturing Systems Lab.
CAD/CAM FOR ASSEMBLY PLANNING Ph.D. Thesis
Peter Martens 1991 149 p Sponsored in part by SPIN
(ISBN-90-370-0057-6; ETN-92-92525) Copyright Avail: CASI HC A07/MF A02

The aim of the project is to study techniques to automate and facilitate assembly planning. The project focuses on product modeling and product model based assembly analysis. The research covers the area of preparation preceding the actual process planning, from product design down. A new model is developed for product and assembly description, and the algorithms to automatically generate this model. The requirements and available techniques for Computer Aided Design/Manufacturing (CAD/CAM) with respect to assembly planning are given. New techniques are developed as available techniques do not suffice. A CAD/CAM system based on the basic techniques founded is introduced. The connection analysis theory, an innovation developed in the context of this project, is explained. A prototype implementation was developed to demonstrate and evaluate the results. The evaluation and a vision of the future of CAD systems are presented. The appendices provide an overview of the products used for evaluation and specification, and an overview of definitions used for connection modeling. The research project learns that the interfaces of a commercial CAD system are not very effective for use in a CAD/CAM system. Future CAD systems will contain much designer support and will behave as a data management system. Apart from assembly planning, a promising use of the presented algorithms could be as a design evaluation tool to judge a product's assembly properties. ESA

N93-17491# Technische Univ., Delft (Netherlands).
THE MULTISCALE AND WAVELET TRANSFORM WITH APPLICATIONS IN WELL LOG ANALYSIS Ph.D. Thesis
Pieter Leonard Vermeer 1992 204 p
(ETN-92-92526) Avail: CASI HC A10/MF A03

Theoretical concepts and applications of the multiscale transform and the wavelet transform are discussed with attention given to well logs. A well log is a sequence of measures obtained from a borehole and a record of the variation in lithology. As part of a geophysical survey, well logs are taken from different boreholes in a certain area. The well logs exhibit differences due to different geological circumstances at the various locations. Dissimilar rates of sedimentation cause the well logs to be stretched or compressed with respect to each other. The multiscale transform and the wavlet transform are defined. Theory concerning inversion and sampling are reviewed. Some properties and examples are given. The theory of discrete orthogonal wavelet bases for discrete time signals is presented. Examination of well logs leads to the observation that they exhibit characteristic behavior over a wide range of scales, differing from one foot to hundreds of feet, not accounted for in conventional segmentation methods. A segmentation method is proposed to solve this problem, based on the multiscale transform and the wavelet transform of the well log. Examples and possibilities for further applications of the segmentation are provided. A signal matching method that can determine the shifts, stretches and compressions of which the deformation between two well logs may consist, is derived and examined. The method involves a minimization technique based on dynamic programming. Experiments are carried out on synthetic data as well as on real well logs. ESA

N93-17499*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
WORKING NOTES FROM THE 1992 AAAI WORKSHOP ON AUTOMATING SOFTWARE DESIGN. THEME: DOMAIN SPECIFIC SOFTWARE DESIGN
Richard M. Keller, ed., David Barstow (Schlumberger Lab. For Computer Science, Austin, TX.), Michael R. Lowry, and Christopher H. Tong (Rutgers - The State Univ., Newark, NJ.) Jul. 1992 161 p Workshop held in San Jose, CA, 12-16 1992
(NASA-TM-108123; FIA-92-18; NAS 1.15:108123) Avail: CASI HC A08/MF A02

The goal of this workshop is to identify different architectural approaches to building domain-specific software design systems and to explore issues unique to domain-specific (vs. general-purpose) software design. Some general issues that cut across the particular software design domain include: (1) knowledge representation, acquisition, and maintenance; (2) specialized software design techniques; and (3) user interaction and user interface. For individual titles, see N93-17500 through N93-17528.

N93-17500*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DEVELOPING SATELLITE GROUND CONTROL SOFTWARE THROUGH GRAPHICAL MODELS
Sidney Bailin (Computer Technology Associates, Inc., Rockville, MD.), Scott Henderson (Computer Technology Associates, Inc., Rockville, MD.), Frank Paterra (Computer Technology Associates, Inc., Rockville, MD.), and Walt Truszkowski *In* NASA. Ames Research Center, Working Notes from the

1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 1-5 (For primary document see N93-17499 05-61)
Avail: CASI HC A01/MF A02

This paper discusses a program of investigation into software development as graphical modeling. The goal of this work is a more efficient development and maintenance process for the ground-based software that controls unmanned scientific satellites launched by NASA. The main hypothesis of the program is that modeling of the spacecraft and its subsystems, and reasoning about such models, can--and should--form the key activities of software development; by using such models as inputs, the generation of code to perform various functions (such as simulation and diagnostics of spacecraft components) can be automated. Moreover, we contend that automation can provide significant support for reasoning about the software system at the diagram level. Author

N93-17501*# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Dept. of Electrical and Computer Engineering.
FORMALIZATION AND VISUALIZATION OF DOMAIN-SPECIFIC SOFTWARE ARCHITECTURES
Paul D. Bailor, David R. Luginbuhl, and John S. Robinson *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 6-10 (For primary document see N93-17499 05-61)
Avail: CASI HC A01/MF A02

This paper describes a domain-specific software design system based on the concepts of software architectures engineering and domain-specific models and languages. In this system, software architectures are used as high level abstractions to formulate a domain-specific software design. The software architecture serves as a framework for composing architectural fragments (e.g., domain objects, system components, and hardware interfaces) that make up the knowledge (or model) base for solving a problem in a particular application area. A corresponding software design is generated by analyzing and describing a system in the context of the software architecture. While the software architecture serves as the framework for the design, this concept is insufficient by itself for supplying the additional details required for a specific design. Additional domain knowledge is still needed to instantiate components of the architecture and develop optimized algorithms for the problem domain. One possible way to obtain the additional details is through the use of domain-specific languages. Thus, the general concept of a software architecture and the specific design details provided by domain-specific languages are combined to create what can be termed a domain-specific software architecture (DSSA). Author

N93-17502*# Stanford Univ., Palo Alto, CA. Knowledge Systems Lab.
THE KASE APPROACH TO DOMAIN-SPECIFIC SOFTWARE SYSTEMS
Sanjay Bhansali and H. Penny Nii *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 11-1 (For primary document see N93-17499 05-61)
Avail: CASI HC A01/MF A02

Designing software systems, like all design activities, is a knowledge-intensive task. Several studies have found that the predominant cause of failures among system designers is lack of knowledge: knowledge about the application domain, knowledge about design schemes, knowledge about design processes, etc. The goal of domain-specific software design systems is to explicitly represent knowledge relevant to a class of applications and use it to partially or completely automate various aspects of the designing systems within that domain. The hope is that this would reduce the intellectual burden on the human designers and lead to more efficient software development. In this paper, we present a domain-specific system built on top of KASE, a knowledge-assisted software engineering environment being developed at the Stanford Knowledge Systems Laboratory. We introduce the main ideas underlying the construction of domain specific systems within KASE, illustrate the application of the idea in the synthesis of a system for tracking aircraft from radar signals, and discuss some of the issues in constructing domain-specific systems.
Author

N93-17503*# GTE Government Systems Corp., Chantilly, VA.
DOMAIN SPECIFIC SOFTWARE ARCHITECTURES: COMMAND AND CONTROL
Christine Braun, William Hatch, Theodore Ruegsegger, Bob Balzer (USC/Information Sciences Inst., Marina Del Rey, CA.), Martin Feather (USC/Information Sciences Inst., Marina Del Rey, CA.), Neil Goldman (USC/Information Sciences Inst., Marina Del Rey, CA.), and Dave Wile (USC/Information Sciences Inst., Marina Del Rey, CA.) *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 16-2 (For primary document see N93-17499 05-61)
(Contracts NCC2-520; DAAB07-92-C-Q502)
Avail: CASI HC A02/MF A02

GTE is the Command and Control contractor for the Domain Specific Software Architectures program. The objective of this program is to develop and demonstrate an architecture-driven, component-based capability for the automated generation of command and control (C2) applications. Such a capability will significantly reduce the cost of C2 applications development and will lead to improved system quality and reliability through the use of proven architectures and components. A major focus of GTE's approach is the automated generation of application components in particular subdomains. Our initial work in this area has concentrated in the message handling subdomain; we have defined and prototyped an approach that can automate one of the most software-intensive parts of C2 systems development. This paper provides an overview of the GTE team's DSSA approach and then presents our work on automated support for message processing. Author

N93-17504*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ISSUES IN KNOWLEDGE REPRESENTATION TO SUPPORT MAINTAINABILITY: A CASE STUDY IN SCIENTIFIC DATA PREPARATION
Steve Chien, R. Kirk Kandt, Joseph Roden, Scott Burleigh, Todd King (California Univ., Los Angeles.), and Steve Joy (California Univ., Los Angeles.) *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 23-2 (For primary document see N93-17499 05-61)
Avail: CASI HC A02/MF A02

Scientific data preparation is the process of extracting usable scientific data from raw instrument data. This task involves noise detection (and subsequent noise classification and flagging or removal), extracting data from compressed forms, and construction of derivative or aggregate data (e.g. spectral densities or running averages). A software system called PIPE provides intelligent assistance to users developing scientific data preparation plans using a programming language called Master Plumber. PIPE provides this assistance capability by using a process description to create a dependency model of the scientific data preparation plan. This dependency model can then be used to verify syntactic and semantic constraints on processing steps to perform limited plan validation. PIPE also provides capabilities for using this model to assist in debugging faulty data preparation plans. In this case, the process model is used to focus the developer's attention upon those processing steps and data elements that were used in computing the faulty output values. Finally, the dependency model of a plan can be used to perform plan optimization and runtime estimation. These capabilities allow scientists to spend less time developing data preparation procedures and more time on scientific analysis tasks. Because the scientific data processing modules (called fittings) evolve to match scientists' needs, issues regarding maintainability are of prime importance in PIPE. This paper describes the PIPE system and describes how issues in maintainability affected the knowledge representation used in PIPE to capture knowledge about the behavior of fittings. Author

N93-17505*# Florida Univ., Gainesville. Dept. of Computer and Information Sciences.
GATOR: REQUIREMENTS CAPTURING OF TELEPHONY FEATURES
Douglas D. Dankel, II, Wayne Walker, and Mark Schmalz *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 29-3 (For primary document see N93-17499 05-61)
Avail: CASI HC A02/MF A02

We are developing a natural language-based, requirements gathering

system called GATOR (for the GATherer Of Requirements). GATOR assists in the development of more accurate and complete specifications of new telephony features. GATOR interacts with a feature designer who describes a new feature, set of features, or capability to be implemented. The system aids this individual in the specification process by asking for clarifications when potential ambiguities are present, by identifying potential conflicts with other existing features, and by presenting its understanding of the feature to the designer. Through user interaction with a model of the existing telephony feature set, GATOR constructs a formal representation of the new, 'to be implemented' feature. Ultimately GATOR will produce a requirements document and will maintain an internal representation of this feature to aid in future design and specification. This paper consists of three sections that describe (1) the structure of GATOR, (2) POND, GATOR's internal knowledge representation language, and (3) current research issues. Author

N93-17506*# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.

MODELING SOFTWARE SYSTEMS BY DOMAINS

Richard DIppolito and Kenneth Lee *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 35-4 Sponsored by DOD (For primary document see N93-17499 05-61)
Avail: CASI HC A02/MF A02

The Software Architectures Engineering (SAE) Project at the Software Engineering Institute (SEI) has developed engineering modeling techniques that both reduce the complexity of software for domain-specific computer systems and result in systems that are easier to build and maintain. These techniques allow maximum freedom for system developers to apply their domain expertise to software. We have applied these techniques to several types of applications, including training simulators operating in real time, engineering simulators operating in non-real time, and real-time embedded computer systems. Our modeling techniques result in software that mirrors both the complexity of the application and the domain knowledge requirements. We submit that the proper measure of software complexity reflects neither the number of software component units nor the code count, but the locus of and amount of domain knowledge. As a result of using these techniques, domain knowledge is isolated by fields of engineering expertise and removed from the concern of the software engineer. In this paper, we will describe kinds of domain expertise, describe engineering by domains, and provide relevant examples of software developed for simulator applications using the techniques. Author

N93-17507*# Rutgers Univ., New Brunswick, NJ. Dept. of Computer Science.

APPROXIMATION, ABSTRACTION AND DECOMPOSITION IN SEARCH AND OPTIMIZATION

Thomas Ellman *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 41-4 (For primary document see N93-17499 05-61)
Avail: CASI HC A01/MF A02

In this paper, I discuss four different areas of my research. One portion of my research has focused on automatic synthesis of search control heuristics for constraint satisfaction problems (CSPs). I have developed techniques for automatically synthesizing two types of heuristics for CSPs: Filtering functions are used to remove portions of a search space from consideration. Another portion of my research is focused on automatic synthesis of hierarchic algorithms for solving constraint satisfaction problems (CSPs). I have developed a technique for constructing hierarchic problem solvers based on numeric interval algebra. Another portion of my research is focused on automatic decomposition of design optimization problems. We are using the design of racing yacht hulls as a testbed domain for this research. Decomposition is especially important in the design of complex physical shapes such as yacht hulls. Another portion of my research is focused on intelligent model selection in design optimization. The model selection problem results from the difficulty of using exact models to analyze the performance of candidate designs. Author

N93-17508*# Stanford Univ., CA. Medical Computer Science Group.

META-TOOLS FOR SOFTWARE DEVELOPMENT AND KNOWLEDGE ACQUISITION

Henrik Eriksson (Linkoeping Univ., Sweden) and Mark A. Musen *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 43-4 Sponsored in cooperation with Digital Equipment Corp., the Swedish Inst., and Fulbright Commission (For primary document see N93-17499 05-61)
(Grants NIH-LM-05157; NIH-LM-05208)
Avail: CASI HC A01/MF A02

The effectiveness of tools that provide support for software development is highly dependent on the match between the tools and their task. Knowledge-acquisition (KA) tools constitute a class of development tools targeted at knowledge-based systems. Generally, KA tools that are custom-tailored for particular application domains are more effective than are general KA tools that cover a large class of domains. The high cost of custom-tailoring KA tools manually has encouraged researchers to develop meta-tools for KA tools. Current research issues in meta-tools for knowledge acquisition are the specification styles, or meta-views, for target KA tools used, and the relationships between the specification entered in the meta-tool and other specifications for the target program under development. We examine different types of meta-views and meta-tools. Our current project is to provide meta-tools that produce KA tools from multiple specification sources--for instance, from a task analysis of the target application. Author

N93-17509*# Fass (Leona F.), Carmel, CA.

SOFTWARE DESIGN AS A PROBLEM IN LEARNING THEORY (A RESEARCH OVERVIEW)

Leona F. Fass *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 48-4 (For primary document see N93-17499 05-61)
Avail: CASI HC A01/MF A02

Our interest in automating software design has come out of our research in automated reasoning, inductive inference, learnability, and algebraic machine theory. We have investigated these areas extensively, in connection with specific problems of language representation, acquisition, processing, and design. In the case of formal context-free (CF) languages we established existence of finite learnable models ('behavioral realizations') and procedures for constructing them effectively. We also determined techniques for automatic construction of the models, inductively inferring them from finite examples of how they should 'behave'. These results were obtainable due to appropriate representation of domain knowledge, and constraints on the domain that the representation defined. It was when we sought to generalize our results, and adapt or apply them, that we began investigating the possibility of determining similar procedures for constructing correct software. Discussions with other researchers led us to examine testing and verification processes, as they are related to inference, and due to their considerable importance in correct software design. Motivating papers by other researchers, led us to examine these processes in some depth. Here we present our approach to those software design issues raised by other researchers, within our own theoretical context. We describe our results, relative to those of the other researchers, and conclude that they do not compare unfavorably. Author

N93-17510*# Bavarian Research Center for Knowledge Based Systems, Erlangen (Germany).

TOWARDS AUTOMATION OF USER INTERFACE DESIGN

Rainer Gastner, Gerhard K. Kraetzschmar, and Ernst Lutz *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 50-5 (For primary document see N93-17499 05-61)
Avail: CASI HC A02/MF A02

This paper suggests an approach to automatic software design in the domain of graphical user interfaces. There are still some drawbacks in existing user interface management systems (UIMS's) which basically offer only quantitative layout specifications via direct manipulation. Our approach suggests a convenient way to get a default graphical user interface which may be customized and redesigned easily in further prototyping cycles. Author

N93-17511*# GTE Labs., Inc., Waltham, MA. Computer and Intelligent Systems Lab.

TOWARD DOMAIN-SPECIFIC DESIGN ENVIRONMENTS: SOME REPRESENTATION IDEAS FROM THE TELECOMMUNICATIONS DOMAIN

Sol Greenspan and Mark Feblowitz *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 56-5 (For primary document see N93-17499 05-61)

Avail: CASI HC A01/MF A02

ACME is an experimental environment for investigating new approaches to modeling and analysis of system requirements and designs. ACME is built on and extends object-oriented conceptual modeling techniques and knowledge representation and reasoning (KRR) tools. The most immediate intended use for ACME is to help represent, understand, and communicate system designs during the early stages of system planning and requirements engineering. While our research is ostensibly aimed at software systems in general, we are particularly motivated to make an impact in the telecommunications domain, especially in the area referred to as Intelligent Networks (IN's). IN systems contain the software to provide services to users of a telecommunications network (e.g., call processing services, information services, etc.) as well as the software that provides the internal infrastructure for providing the services (e.g., resource management, billing, etc.). The software includes not only systems developed by the network proprietors but also by a growing group of independent service software providers. Author

N93-17512*# Bell Telephone Labs., Inc., Murray Hill, NJ.

INTERACTIVE SPECIFICATION ACQUISITION VIA SCENARIOS: A PROPOSAL

Robert J. Hall *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 60-6 (For primary document see N93-17499 05-61)

Avail: CASI HC A02/MF A02

Some reactive systems are most naturally specified by giving large collections of behavior scenarios. These collections not only specify the behavior of the system, but also provide good test suites for validating the implemented system. Due to the complexity of the systems and the number of scenarios, however, it appears that automated assistance is necessary to make this software development process workable. Interactive Specification Acquisition Tool (ISAT) is a proposed interactive system for supporting the acquisition and maintenance of a formal system specification from scenarios, as well as automatic synthesis of control code and automated test generation. This paper discusses the background, motivation, proposed functions, and implementation status of ISAT. Author

N93-17513*# Stanford Univ., CA. Knowledge Systems Lab.

DISTRIBUTED INTELLIGENT CONTROL AND MANAGEMENT (DICAM) APPLICATIONS AND SUPPORT FOR SEMI-AUTOMATED DEVELOPMENT

Frederick Hayes-Roth (Teknowledge Federal Systems, Inc., Palo Alto, CA.), Lee D. Erman (Teknowledge Federal Systems, Inc., Palo Alto, CA.), Allan Terry, tk192632, and Barbara Hayes-Roth *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 66-7 (For primary document see N93-17499 05-61)

Avail: CASI HC A01/MF A02

We have recently begun a 4-year effort to develop a new technology foundation and associated methodology for the rapid development of high-performance intelligent controllers. Our objective in this work is to enable system developers to create effective real-time systems for control of multiple, coordinated entities in much less time than is currently required. Our technical strategy for achieving this objective is like that in other domain-specific software efforts: analyze the domain and task underlying effective performance, construct parametric or model-based generic components and overall solutions to the task, and provide excellent means for specifying, selecting, tailoring or automatically generating the solution elements particularly appropriate for the problem at hand. In this paper, we first present our specific domain focus, briefly describe the methodology and environment we are developing to provide a more regular approach to software development, and then later describe the issues this raises for the research community and this specific workshop. Author

N93-17514*# Austin Biological Labs., TX.

MODEL-BASED SOFTWARE DESIGN

Neil Iscoe, Zheng-Yang Liu, Guohui Feng, Britt Yenne, Larry VanSickle, and Michael Ballantyne *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 72-7 Presented at the Asilomar Workshop on Change of Representation and Problem Reformulation, Apr. 1992 (For primary document see N93-17499 05-61)

Avail: CASI HC A02/MF A02

Domain-specific knowledge is required to create specifications, generate code, and understand existing systems. Our approach to automating software design is based on instantiating an application domain model with industry-specific knowledge and then using that model to achieve the operational goals of specification elicitation and verification, reverse engineering, and code generation. Although many different specification models can be created from any particular domain model, each specification model is consistent and correct with respect to the domain model. Author

N93-17515*# Siemens A.G., Vienna (Austria).

DESCRIPTION OF RESEARCH INTERESTS AND CURRENT WORK RELATED TO AUTOMATING SOFTWARE DESIGN

Hermann Kaindl *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 78-7 (For primary document see N93-17499 05-61)

Avail: CASI HC A01/MF A02

Enclosed is a list of selected and recent publications. Most of these publications concern applied research in the areas of software engineering and human-computer interaction. It is felt that domain-specific knowledge plays a major role in software development. Additionally, it is believed that improvements in the general software development process (e.g., object-oriented approaches) will have to be combined with the use of large domain-specific knowledge bases. Author

N93-17516*# Schlumberger Lab. For Computer Science, Austin, TX.

AUTOMATING THE DESIGN OF SCIENTIFIC COMPUTING SOFTWARE

Elaine Kant *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 80-8 (For primary document see N93-17499 05-61)

Avail: CASI HC A02/MF A02

SINAPSE is a domain-specific software design system that generates code from specifications of equations and algorithm methods. This paper describes the system's design techniques (planning in a space of knowledge-based refinement and optimization rules), user interaction style (user has option to control decision making), and representation of knowledge (rules and objects). It also summarizes how the system knowledge has evolved over time and suggests some issues in building software design systems to facilitate reuse. Author

N93-17517*# McDonnell Aircraft Co., Saint Louis, MO.

DOMAIN SPECIFIC SOFTWARE DESIGN FOR DECISION AIDING

Kirby Keller and Kevin Stanley *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 86-9 (For primary document see N93-17499 05-61)

Avail: CASI HC A02/MF A02

McDonnell Aircraft Company (MCAIR) is involved in many large multi-discipline design and development efforts of tactical aircraft. These involve a number of design disciplines that must be coordinated to produce an integrated design and a successful product. Our interpretation of a domain specific software design (DSSD) is that of a representation or framework that is specialized to support a limited problem domain. A DSSD is an abstract software design that is shaped by the problem characteristics. This parallels the theme of object-oriented analysis and design of letting the problem model directly drive the design. The DSSD concept extends the notion of software reusability to include representations or frameworks. It supports the entire software life cycle and specifically

leads to improved prototyping capability, supports system integration, and promotes reuse of software designs and supporting frameworks. The example presented in this paper is the task network architecture or design which was developed for the MCAIR Pilot's Associate program. The task network concept supported both module development and system integration within the domain of operator decision aiding. It is presented as an instance where a software design exhibited many of the attributes associated with DSSD concept. Author

N93-17518*# Sterling Software, Moffett Field, CA. Artificial Intelligence Research Branch.

KNOWLEDGE-INTENSIVE SOFTWARE DESIGN SYSTEMS: CAN TOO MUCH KNOWLEDGE BE A BURDEN?

Richard M. Keller *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 93-9 Previously announced as N92-25444 (For primary document see N93-17499 05-61)

Avail: CASI HC A02/MF A02

While acknowledging the considerable benefits of domain-specific, knowledge-intensive approaches to automated software engineering, it is prudent to carefully examine the costs of such approaches, as well. In adding domain knowledge to a system, a developer makes a commitment to understanding, representing, maintaining, and communicating that knowledge. This substantial overhead is not generally associated with domain-independent approaches. In this paper, I examine the downside of incorporating additional knowledge, and illustrate with examples based on our experience in building the SIGMA system. I also offer some guidelines for developers building domain-specific systems. Author

N93-17519*# Academy of Sciences of the Ukrainian SSR, Kharkov.

AUTOMATING SOFTWARE DESIGN SYSTEM DESTA

Vladimir A. Lovitsky and Patricia D. Pearce (Plymouth Polytechnic, England) *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 99-104 (For primary document see N93-17499 05-61)

Avail: CASI HC A02/MF A02

'DESTA' is the acronym for the Dialogue Evolutionary Synthesizer of Turnkey Algorithms by means of a natural language (Russian or English) functional specification of algorithms or software being developed. DESTA represents the computer-aided and/or automatic artificial intelligence 'forgiving' system which provides users with software tools support for algorithm and/or structured program development. The DESTA system is intended to provide support for the higher levels and earlier stages of engineering design of software in contrast to conventional Computer Aided Design (CAD) systems which provide low level tools for use at a stage when the major planning and structuring decisions have already been taken. DESTA is a knowledge-intensive system. The main features of the knowledge are procedures, functions, modules, operating system commands, batch files, their natural language specifications, and their interlinks. The specific domain for the DESTA system is a high level programming language like Turbo Pascal 6.0. The DESTA system is operational and runs on an IBM PC computer. Author

N93-17520*# City Univ., London (England). Dept. of Business Computing.

GENERIC DOMAIN MODELS IN SOFTWARE ENGINEERING

Neil Maiden *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 105-110 (For primary document see N93-17499 05-61)

Avail: CASI HC A02/MF A02

This paper outlines three research directions related to domain-specific software development: (1) reuse of generic models for domain-specific software development; (2) empirical evidence to determine these generic models, namely elicitation of mental knowledge schema possessed by expert software developers; and (3) exploitation of generic domain models to assist modelling of specific applications. It focuses on knowledge acquisition for domain-specific software development, with emphasis on tool support for the most important phases of software development. Author

N93-17521*# Bell Telephone Labs., Inc., Murray Hill, NJ.

DOMAIN-SPECIFIC FUNCTIONAL SOFTWARE TESTING: A PROGRESS REPORT

Uwe Nonnenmann *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 111-114 (For primary document see N93-17499 05-61)

Avail: CASI HC A01/MF A02

Software Engineering is a knowledge intensive activity that involves defining, designing, developing, and maintaining software systems. In order to build effective systems to support Software Engineering activities, Artificial Intelligence techniques are needed. The application of Artificial Intelligence technology to Software Engineering is called Knowledge-based Software Engineering (KBSE). The goal of KBSE is to change the software life cycle such that software maintenance and evolution occur by modifying the specifications and then rederiving the implementation rather than by directly modifying the implementation. The use of domain knowledge in developing KBSE systems is crucial. Our work is mainly related to one area of KBSE that is called automatic specification acquisition. One example is the WATSON prototype on which our current work is based. WATSON is an automatic programming system for formalizing specifications for telephone switching software mainly restricted to POTS, i.e., plain old telephone service. Our current approach differentiates itself from other approaches in two antagonistic ways. On the one hand, we address a large and complex real-world problem instead of a 'toy domain' as in many research prototypes. On the other hand, to allow such scaling, we had to relax the ambitious goal of complete automatic programming, to the easier task of automatic testing. Author

N93-17522*# Michigan State Univ., East Lansing.

A DOMAIN-SPECIFIC DESIGN ARCHITECTURE FOR COMPOSITE MATERIAL DESIGN AND AIRCRAFT PART REDESIGN

W. F. Punch, III, K. J. Keller, W. Bond (McDonnell Aircraft Co., Saint Louis, MO.), and J. Sticklen (Michigan State Univ., East Lansing.) *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 115-120 (For primary document see N93-17499 05-61)

Avail: CASI HC A02/MF A02

Advanced composites have been targeted as a 'leapfrog' technology that would provide a unique global competitive position for U.S. industry. Composites are unique in the requirements for an integrated approach to designing, manufacturing, and marketing of products developed utilizing the new materials of construction. Numerous studies extending across the entire economic spectrum of the United States from aerospace to military to durable goods have identified composites as a 'key' technology. In general there have been two approaches to composite construction: build models of a given composite materials, then determine characteristics of the material via numerical simulation and empirical testing; and experience-directed construction of fabrication plans for building composites with given properties. The first route sets a goal to capture basic understanding of a device (the composite) by use of a rigorous mathematical model; the second attempts to capture the expertise about the process of fabricating a composite (to date) at a surface level typically expressed in a rule based system. From an AI perspective, these two research lines are attacking distinctly different problems, and both tracks have current limitations. The mathematical modeling approach has yielded a wealth of data but a large number of simplifying assumptions are needed to make numerical simulation tractable. Likewise, although surface level expertise about how to build a particular composite may yield important results, recent trends in the KBS area are towards augmenting surface level problem solving with deeper level knowledge. Many of the relative advantages of composites, e.g., the strength:weight ratio, is most prominent when the entire component is designed as a unitary piece. The bottleneck in undertaking such unitary design lies in the difficulty of the re-design task. Designing the fabrication protocols for a complex-shaped, thick section composite are currently very difficult. It is in fact this difficulty that our research will address. Author

N93-17523*# Pittsburgh Univ., PA. Electrical Engineering Dept.

RT-SYN: A REAL-TIME SOFTWARE SYSTEM GENERATOR

Dorothy E. Setliff *In* NASA. Ames Research Center, Working Notes

from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 121-126 (For primary document see N93-17499 05-61)
Avail: CASI HC A02/MF A02

This paper presents research into providing highly reusable and maintainable components by using automatic software synthesis techniques. This proposal uses domain knowledge combined with automatic software synthesis techniques to engineer large-scale mission-critical real-time software. The hypothesis centers on a software synthesis architecture that specifically incorporates application-specific (in this case real-time) knowledge. This architecture synthesizes complex system software to meet a behavioral specification and external interaction design constraints. Some examples of these external constraints are communication protocols, precisions, timing, and space limitations. The incorporation of application-specific knowledge facilitates the generation of mathematical software metrics which are used to narrow the design space, thereby making software synthesis tractable. Success has the potential to dramatically reduce mission-critical system life-cycle costs not only by reducing development time, but more importantly facilitating maintenance, modifications, and extensions of complex mission-critical software systems, which are currently dominating life cycle costs. Author

N93-17524*# Kent State Univ., OH. Dept. of Mathematics and Computer Science.
AUTOMATING FEA PROGRAMMING
Naveen Sharma *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 127-133 (For primary document see N93-17499 05-61)
Avail: CASI HC A02/MF A02

In this paper we briefly describe a combined symbolic and numeric approach for solving mathematical models on parallel computers. An experimental software system, PIER, is being developed in Common Lisp to synthesize computationally intensive and domain formulation dependent phases of finite element analysis (FEA) solution methods. Quantities for domain formulation like shape functions, element stiffness matrices, etc., are automatically derived using symbolic mathematical computations. The problem specific information and derived formulae are then used to generate (parallel) numerical code for FEA solution steps. A constructive approach to specify a numerical program design is taken. The code generator compiles application oriented input specifications into (parallel) FORTRAN77 routines with the help of built-in knowledge of the particular problem, numerical solution methods and the target computer. Author

N93-17525*# Calgary Univ. (Alberta). Knowledge Science Institute.
KNOWLEDGE MODELING FOR SOFTWARE DESIGN
Mildred L. G. Shaw and Brian R. Gaines *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 134-138 (For primary document see N93-17499 05-61)
Avail: CASI HC A01/MF A02

This paper develops a modeling framework for systems engineering that encompasses systems modeling, task modeling, and knowledge modeling, and allows knowledge engineering and software engineering to be seen as part of a unified developmental process. This framework is used to evaluate what novel contributions the 'knowledge engineering' paradigm has made and how these impact software engineering. Author

N93-17526*# Edinburgh Univ. (Scotland).
THE USE OF TYPED LAMBDA CALCULUS FOR COMPREHENSION AND CONSTRUCTION OF SIMULATION MODELS IN THE DOMAIN OF ECOLOGY
Michael Uschold *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 139 (For primary document see N93-17499 05-61)
Avail: CASI HC A01/MF A02

We are concerned with two important issues in simulation modelling: model comprehension and model construction. Model comprehension is limited because many important choices taken during the modelling process are not documented. This makes it difficult for models to be modified or used by others. A key factor hindering model construction is the vast modelling search space which must be navigated. This is exacerbated by the fact that many modellers are unfamiliar with the terms and concepts catered to by current tools. The root of both problems is the lack of facilities for representing or reasoning about domain concepts in current simulation technology. The basis for our achievements in both of these areas is the development of a language with two distinct levels; one for representing domain information, and the other for representing the simulation model. Of equal importance, is the fact that we make formal connections between these two levels. The domain we are concerned with is ecological modelling. This language, called Elklogic, is based on the typed lambda calculus. Important features include a rich type structure, the use of various higher order functions, and semantics. This enables complex expressions to be constructed from relatively few primitives. The meaning of each expression can be determined in terms of the domain, the simulation model, or the relationship between the two. We describe a novel representation for sets and substructure, and a variety of other general concepts that are especially useful in the ecological domain. We use the type structure in a novel way: for controlling the modelling search space, rather than a proof search space. We facilitate model comprehension by representing modelling decisions that are embodied in the simulation model. We represent the simulation model separately from, but in terms of a domain mode. The explicit links between the two models constitute the modelling decisions. The semantics of Elklogic enables English text to be generated to explain the simulation model in domain terms. Author

N93-17527*# Rutgers Univ., New Brunswick, NJ.
KNOWLEDGE-BASED DESIGN OF GENERATE-AND-PATCH PROBLEM SOLVERS THAT SOLVE GLOBAL RESOURCE ASSIGNMENT PROBLEMS
Kerstin Voigt *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 141-147 (For primary document see N93-17499 05-61)
(Contract NAG2-645; N00014-85-K-0116; NSF IRI-90-17121; NSF DMC-86-10507)
Avail: CASI HC A02/MF A02

We present MENDER, a knowledge based system that implements software design techniques that are specialized to automatically compile generate-and-patch problem solvers that satisfy global resource assignments problems. We provide empirical evidence of the superior performance of generate-and-patch over generate-and-test: even with constrained generation, for a global constraint in the domain of '2D-floorplanning'. For a second constraint in '2D-floorplanning' we show that even when it is possible to incorporate the constraint into a constrained generator, a generate-and-patch problem solver may satisfy the constraint more rapidly. We also briefly summarize how an extended version of our system applies to a constraint in the domain of 'multiprocessor scheduling'. Author

N93-17528*# Unisys Corp., Paoli, PA.
CARDS: A BLUEPRINT AND ENVIRONMENT FOR DOMAIN-SPECIFIC SOFTWARE REUSE
Kurt C. Wallnau, Anne Costa Solderitsch, and Catherine Smotherman *In* NASA. Ames Research Center, Working Notes from the 1992 AAAI Workshop on Automating Software Design. Theme: Domain Specific Software Design Jul. 1992 p 148-152 (For primary document see N93-17499 05-61)
Avail: CASI HC A01/MF A02

CARDS (Central Archive for Reusable Defense Software) exploits advances in domain analysis and domain modeling to identify, specify, develop, archive, retrieve, understand, and reuse domain-specific software components. An important element of CARDS is to provide visibility into the domain model artifacts produced by, and services provided by, commercial computer-aided software engineering (CASE) technology. The use of commercial CASE technology is important to provide rich, robust support for the varied roles involved in a reuse process. We refer to this kind of use of knowledge representation systems as supporting 'knowledge-based integration.' Author

N93-17533# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
LAZY SCANNER GENERATION FOR MODULAR REGULAR GRAMMARS
P. Klint (Amsterdam Univ., Netherlands) Dec. 1991 21 p Revised

Sponsored in part by EEC, and Netherlands Organization for Scientific Research
(CWI-CS-R9158-Rev; ETN-92-92499) Copyright Avail: CASI HC A03/MF A01

The problem of combining regular grammars appearing in separate modules and of combining the lexical scanners generated for them is addressed. When formal language definitions become large it may be advantageous to divide them into separate modules. Such modules can then be combined in various ways, but this requires that implementations derived from individual modules can be combined as well. This occurs, for instance, in interactive development environments for modular language definitions. The algorithm presented is an extension to the Incremental Scanner Generator (ISG). The resulting Modular Scanner Generator (MSG) shows that the method of selecting a subautomaton from the large automaton corresponding to all regular expressions in all modules is superior to the method of constructing a new automaton for each selection of modules. The method requires only tenths of seconds. ESA

N93-17554# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
A NUMERICAL MODEL OF THE NORTHWEST EUROPEAN CONTINENTAL SHELF ON THE CRAY Y-MP2E
E. D. deGoede Dec. 1991 18 p Sponsored by Rijkswaterstraat
(CWI-NM-R9119; ETN-92-92505) Copyright Avail: CASI HC A03/MF A01

A numerical model for the shallow water equations in polar coordinates was applied to the northwest European continental shelf. Both a two dimensional and a three dimensional model of the continental shelf was investigated. A simulation was carried out for the period of 9-12 Feb. 1989. The time splitting method used consists of two stages and is unconditionally stable; moreover, it can fully exploit vector and parallel facilities of supercomputers. Three dimensional shallow water models require a great computational effort and it is therefore necessary to use such fast computers. In a previous paper the same continental shelf problem was examined. The numerical results are in good agreement with each other. It appears that the amplitude and phase errors are small. The numerical experiments are carried out on the one processor Cray Y-MP2E. This superconductor is used for the simulation of large scale models of rivers and seas in the Netherlands. ESA

N93-17594# Nijmegen Univ. (Netherlands). Dept. of Informatics.
ON THE BORDERLINE BETWEEN GRAMMARS AND PROGRAMS
C. H. A. Koster and J. G. Beney (Institut National des Sciences Appliquees de Lyon, Villeurbanne, France) Aug. 1991 13 p Presented at PLILP Conference, Brussels, Belgium, Aug. 1991
(TR-91-17; ETN-92-92537) Avail: CASI HC A03/MF A01

Some of the engineering considerations and tradeoffs in the design of a Compiler Description Language (CDL3) are described. The language is based on extended affix grammars, where the affix rules are used to define tree types. The execution model is deterministic and depth-first, except that part of the work can be delayed until a second pass over the implicit parse tree. It is checked statically whether the program can indeed be executed in two passes without backtracking. A simple module structure allows separate compilation in a safe way. As a running example, the translation of a block structured language is addressed. ESA

N93-17599# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics.
COMPUTER-GENERATED GRATINGS Ph.D. Thesis
Antti Vasara 1991 40 p Sponsored by Suomen Akatemia
(ISBN-951-22-0785-0; ETN-92-92610) Avail: CASI HC A03/MF A01

The analysis and design of computer generated gratings or periodic computer generated holograms is presented. Rigorous diffraction theory is applied for the first time to analyze computer generated gratings. The region of validity of the scalar theories in calculating the diffraction pattern of several types of binary and multilevel surface relief gratings is studied. Novel types of resonance domain gratings are optimized using the electromagnetic diffraction theory and experimentally demonstrated in the far infrared. The storage of multiple images in a Fourier domain hologram is proposed and theoretically verified. New optimization techniques and phase grating geometries are introduced. They are suitable for demanding array generation applications in digital optics. The feasibility of the available grating coding schemes in terms of the ease of fabrication, reconstruction fidelity, and efficiency are considered. Even-orders-missing gratings are recommended to be used whenever possible due to the very lenient accuracy requirements on their fabrication process. When small spot arrays are desired, the stripe geometry Dammann gratings can achieve very high efficiencies despite the binary phase profile. Very large fanout is possible with the crossed phi-phase delay Dammann gratings. The cellular kinoforms designed using the iterative Fourier transform algorithm provide the best results when nonseparable large spot arrays are needed. Fabrication of stepped phase kinoforms is feasible with current techniques when either the detour phase or hybrid kinoform methods are used. ESA

N93-17640# Institut National Polytechnique, Grenoble (France). Lab. de Genie Informatique.
STUDY OF AN ADAPTIVE MAINTENANCE STRATEGY FOR LOGIC SYSTEMS Ph.D. Thesis [ETUDE D'UNE STRATEGIE DE MAINTENANCE ADAPTIVE POUR DES SYSTEMES LOGIQUES]
Nouar Garcia-Mardambek 1991 213 p In FRENCH
(ETN-92-92673) Avail: CASI HC A10/MF A03

The complexity of digital equipment induces growing difficulties concerning inspection operations. Specific checking procedures are required. The purpose of the study was to develop a strategy for establishing a sequence of adapted tests. The strategy gives a functional specification to the maintenance program. The problem found is similar to that involving a Boolean matrix. A classic and a heuristic method are proposed. Concerning the classic method, the problem to be solved is similar to converting a conjunctive into a disjunctive formula. Techniques of artificial intelligence, used in the heuristic process, give an optimal solution for given criteria. Different artificial intelligence techniques are compared and expert system solutions are summarized. For programming and validating the different methods, an OPS5 system was used. ESA

N93-17669# Naval Postgraduate School, Monterey, CA.
A CLEARINGHOUSE FOR SOFTWARE REUSE: LESSONS LEARNED FROM THE RAPID/DSRS INITIATIVES M.S. Thesis
Gerard R. Harms and Tina H. VanHook Sep. 1992 52 p
(AD-A257743) Avail: CASI HC A04/MF A01

Information Systems executives within the Department of Defense (DoD) activities are being challenged to develop innovative ways in which information technology can contribute to the streamlining of DoD organizations. Software Reuse is a key strategy in developing information systems that will meet the future needs of DoD organizations. This thesis examines the concepts, implementation strategies, and issues relating to the creation of a clearinghouse to facilitate and promote software reuse. Specifically it studies the Defense Software Repository System (DSRS), a DoD version of the Reusable Ada Products for the Information Systems Development (RAPID) effort. GRA

N93-17672# Naval Postgraduate School, Monterey, CA.
MODELING CLOSURE OF ARMY MATERIEL COMMAND INSTALLATIONS: A BI-CRITERIA MIXED INTEGER PROGRAMMING APPROACH M.S. Thesis
William J. Tarantino Sep. 1992 84 p
(AD-A257755) Avail: CASI HC A05/MF A01

The Army is reducing and reshaping its force structure to adapt to the nation's changing defense needs and budget constraints. In response to these changes, Army Materiel Command (AMC) will submit facility realignment and closure recommendations in FY93 and FY95. This thesis develops a bi-criteria mixed integer programming model with the objectives of minimizing operating costs and maximizing a measure of military value to assist AMC in the generation of alternative realignments. Realignment of depot maintenance, research and development, test and evaluation, and administrative functions are considered on 32 AMC installations. An extensive empirical study demonstrates the applicability of the developed approach. GRA

N93-17723# Paramax Systems Corp., Reston, VA.
INTEGRATING DOMAIN-SPECIFIC REUSE FOR SYSTEM/SOFTWARE ENGINEERS COURSE DESCRIPTION
19 Jun. 1992 37 p
(Contract F19628-88-D-0031)
(AD-A257637; STARS-AC-04102/001/00) Avail: CASI HC A03/MF A01

This course provides system and software engineers an introduction to system development with domain-specific software reuse. A domain is a set of current and future applications marked by a set of common capabilities and data. Domain-specific software reuse is the reuse of ideas, knowledge, artifacts, personnel and software components in an existing domain. The course introduces the methods necessary to integrate domain-specific software reuse concepts into current system and software development processes by emphasizing domain analysis, generic architecture development, specific architecture development, and system composition. This course is intended for use in both government and industry training. The course could be tailored for presentation at the university level. GRA

N93-17729# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
IMAGE REPRESENTATION OF I(SUB 2) 2D SYSTEMS WITH FINITE DIMENSIONAL AUTONOMOUS PART
P. Rocha 1992 10 p
(Rept-92-24; ETN-93-93118) Copyright Avail: CASI HC A02/MF A01

Preliminary results on the solvability of the image representation problem for the class of I(sub 2) AR systems are presented. The structure of two dimensional (2D) systems with I(sub 2) signals is analyzed. In particular, for the class of (deterministic) AR systems, the consequences of the square summability requirement in the system description are investigated. ESA

N93-17730# Virginia Univ. Hospital, Charlottesville. Dept. of Computer Science.
THE STARLITE PROJECT: PROTOTYPING REAL-TIME SOFTWARE Annual Report, 1 Oct. 1991 - 30 Sep. 1992
Snag H. Son Nov. 1992 96 p
(Contract N00014-91-J-1102)
(AD-A257773; UVA/525449/CS93/102) Avail: CASI HC A05/MF A01

The StarLite Project has the goal of discovering a set of design principles and developing efficient algorithms for distributed real-time systems. The initial focus of the project is on scheduling algorithms and database systems. The project also involves the construction of a prototyping environment that support experimentation with concurrent and distributed/parallel algorithms for performance testing. One of the most important achievements in this project is the development of new scheduling algorithms based on the idea of adjusting the serialization order of active transactions dynamically. When compared with conventional transaction scheduling algorithms, our algorithms significantly improve the percentage of high priority transactions that meet the deadline. In addition, we have developed experimental database systems for performance evaluation of new technology. The RTDB server on ARTS kernel is extended to support application programmatic interface, graphic user interface, imprecise computing server, indexing mechanism, and distributed multiple server. GRA

N93-17733# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
CHOICE OF WORKING LANGUAGES IN A EUROPEAN WORKING GROUP FOR MULTI-CRITERIA DECISION AID
F. A. Lootsma, L. Rog, and M. Kok 1992 12 p
(Rept-92-27; ETN-93-93120) Copyright Avail: CASI HC A03/MF A01

The choice of languages for international communication in arts and sciences, industry, and trade, presumably affected by the political revolutions of 1989 in Central and Eastern Europe, is addressed. A multicriteria analysis of four alternative combinations of languages under five criteria, to support the choice of working languages in a hitherto bilingual European working group, is proposed. The preliminary test results with the pairwise comparison method in the multiplicative AHP (Analytic Hierarchy Process) and with the direct rating method in SMART (Simple Multi Attribute Rating Technique) are presented. The prospects of the proposed procedure and its chance to support the final decision are discussed. ESA

N93-17765# Naval Postgraduate School, Monterey, CA.
BUILDING REUSABLE SOFTWARE COMPONENTS FOR AUTOMATED RETRIEVAL M.S. Thesis
Jennie M. Sealander Sep. 1992 100 p
(AD-A257605) Avail: CASI HC A05/MF A02

The Computer Aided Photo-typing System (CAPS) is designed to rapidly build prototypes of real-time systems through the automated retrieval of reusable software components. A critical element in achieving this goal is a mechanism for automated retrieval of reusable software components from a software base. There were two major objectives of this thesis: (1) to select and prepare software components for inclusion in the CAPS software base; (2) to design and implement a translation tool which takes an Ada specification as input and generates the prototype system description language (PSDL) interface required for storage and retrieval in the CAPS software base this is necessary since for a component to be usable in the CAPS software base, it must be specified in PSDL. We described the abstraction and implementation of the selected components, introduced the translator, and demonstrated the behaviors of the translator via examples. GRA

N93-17766# Naval Postgraduate School, Monterey, CA.
TURTLE GRAPHICS IMPLEMENTATION USING A GRAPHICAL DATAFLOW PROGRAMMING APPROACH M.S. Thesis
Robert S. Lovejoy Sep. 1992 93 p
(AD-A257606) Avail: CASI HC A05/MF A01

This thesis expands the concepts of object-oriented programming to implement a visual dataflow programming language. The main thrust of this research is to develop a functional prototype language, based upon the Turtle Graphics tool provided by LOGO programming language, for children to develop both their problem solving skills, as well as their general programming skills. The language developed for this thesis was implemented in the object-oriented, dataflow programming language Prograph. The dataflow paradigm was emulated in order to provide a more intuitive, easy to learn programming environment for children to use. Additionally, Prograph was chosen because it provides the necessary base classes to easily implement an interactive user interface, and it provides the necessary primitive operations for all graphics drawing routines. This thesis demonstrates a prototype for a potential visual programming language that can be used at all levels of education to teach problem solving, higher-order thinking skills, mathematical concepts, and the fundamentals of computer science. GRA

N93-17791# Stanford Univ., CA. Systems Optimization Lab.
LARGE-SCALE SEQUENTIAL QUADRATIC PROGRAMMING ALGORITHMS
Samuel K. Eldersveld Sep. 1992 91 p
(Contract N00014-90-J-1242)
(AD-A257643; SOL-92-4) Avail: CASI HC A05/MF A01

The problem addressed is the general nonlinear programming problem: finding a local minimizer for a nonlinear function subject to a mixture of nonlinear equality and inequality constraints. The methods studied are in the class of sequential quadratic programming (SQP) algorithms, which have previously proved successful for problems of moderate size. Our goal is to devise an SQP algorithm that is applicable to large-scale optimization problems, using sparse data structures and storing less curvature information but maintaining the property of superlinear convergence. The main features are: (1) The use of a quasi-Newton approximation to the reduced Hessian of the Lagrangian function. Only an estimate of the reduced Hessian matrix is required by our algorithm. The impact of not having available the full Hessian approximation is studied and alternative estimates are constructed. (2) The use of a transformation matrix Q. This allows the QP gradient to be computed easily when only the reduced Hessian approximation is maintained. (3) The use of a reduced-gradient form of the basis for the null space of the working set. This choice of basis is more practical than an orthogonal null-space basis for large-scale problems. The continuity condition for this choice is proven. (4) The use of incomplete solutions of quadratic programming subproblems. Certain iterates generated by an active-set method for the QP subproblem are used in place of the QP minimizer to define the search direction for the nonlinear problem. An implementation of the new algorithm has been obtained by modifying the code AIINOS. Results and comparisons with AIINOS and NPSOL are given for the new algorithm on a set of 92 test problems. GRA

N93-17808# Naval Command, Control and Ocean Surveillance Center, San Diego, CA.
ENVIRONMENT/TOOL INTEGRATOR FOR SOFTWARE DEVELOPMENT, VERSION 1.1 Final Report, Oct. 1991 - Sep. 1992
N. T. Tran and R. H. Mumm Aug. 1992 36 p
(AD-A257607; NRAD-TR-1548) Avail: CASI HC A03/MF A01

This report describes the environment/tool integrator (ETI) that was developed under the Software Engineering Environment Prototypes (SWEEP) task of the Software Engineering for Command Control and Communications (C3) Systems project. The ETI is a windowing framework for accessing the diverse collections of software tools used by software development projects. It can easily be customized to satisfy the unique needs of specific projects. GRA

N93-15737# MATRA Espace, Toulouse (France).
CAD TO FEM TOOL
N. Jourdon, A. Mavrogenis, and M. Klein (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 633-639 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-15739# Centre National d'Etudes Spatiales, Toulouse (France).
INTEGRATION OF CAD TOOLS IN SPACE VEHICLE DESIGN
J. L. LeGal *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 647-650 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-15772# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
EQUATIONS OF MOTION OF MULTIBODY SYSTEMS IN THE ESA-MIDAS SOFTWARE
Duc Minh Tran *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 871-876 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

N93-16762*# State Univ. of New York, Buffalo. Dept. of Mechanical and Aerospace Engineering.
AN INTELLIGENT DECOMPOSITION APPROACH FOR EFFICIENT DESIGN OF NON-HIERARCHIC SYSTEMS
Christina L. Bloebaum *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 75-78 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16774*# Hope College, Holland, MI. Dept. of Computer Science.
CREATING AN OPEN ENVIRONMENT SOFTWARE INFRASTRUCTURE
Michael J. Jipping *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 128-129 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16777*# Norfolk State Univ., VA. Dept. of Computer Science.
QUANTIFYING PARAMETERS FOR BAYESIAN PRIOR ASSUMPTIONS WHEN ESTIMATING THE PROBABILITY OF FAILURE OF SOFTWARE
Jacquelyn E. Long *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 136-138 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16778*# University of Southern Illinois, Carbondale. Dept. of Physics.
VARIATIONAL DERIVATION OF EQUATION FOR GENERALIZED PAIR CORRELATION FUNCTION
F. Bary Malik *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 139-141 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-16795*# Paul D. Camp Community Coll., Suffolk, VA. Dept. of Computer Information Systems.
DESKTOP COMPUTING INTEGRATION PROJECT
Robert L. Tureman, Jr. *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 187-188 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17296*# Capitol Coll., Laurel, MD. Dept. of Mathematics and Computer Engineering.
GUIDE TO OBJECT-ORIENTED ANALYSIS AND DESIGN
Harry C. Harrison *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17305*# Bronx Community Coll., NY. Dept. of Engineering Technologies.
USING SOFTWARE METRICS AND SOFTWARE RELIABILITY MODELS TO ATTAIN ACCEPTABLE QUALITY SOFTWARE FOR FLIGHT AND GROUND SUPPORT SOFTWARE FOR AVIONIC SYSTEMS
Stella Lawrence *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 6 p (For primary document see N93-17279 05-80)
Avail: CASI HC A02/MF A03

N93-17306*# Florida Univ., Gainesville. Dept. of Astronomy.
AN ALGORITHM TO QUANTIFY THE PERFORMANCE OF THE JOVE PROGRAM
George Lebo *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 3 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17321*# West Virginia Inst. of Tech., Montgomery. Dept. of Electrical Engineering.
SEDS1 MISSION SOFTWARE VERIFICATION USING A SIGNAL SIMULATOR
William E. Pierson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N93-15789*# Sverdrup Technology, Inc., Brook Park, OH.
LEWIS ONLINE TRAVEL SYSTEM: PREPARER'S/TRAVELER'S MANUAL, RELEASE 1.0 Final Report
Michael Seese Nov. 1992 168 p
(Contract NAS3-25266)
(NASA-CR-190776; E-7389; NAS 1.26:190776) Avail: CASI HC A08/MF A02

The Lewis Online Travel System (LOTS) is a menu-driven interactive application that automates nearly all of the functions associated with government travel. The purpose of this manual is to provide LOTS users with concise instructions for using the computerized application. As such, it will not go into the details of travel regulations. Author

N93-15880# Los Alamos National Lab., NM.
HIGH SPEED NETWORKS, VISUALIZATION, AND MASSIVE PARALLELISM IN THE ADVANCED COMPUTING LABORATORY
D. W. Forslund, C. Hansen, P. Hinker, W. St.John, and S. Tenbrink 1992 8 p Presented at the Symposium for High Performance Computing for Flight Vehicles, Washington, DC, 7-9 Dec. 1992
(Contract W-7405-eng-36)
(DE92-017412; LA-UR-92-1753; CONF-921210-2) Avail: CASI HC A02/MF A01

Very high performance massively parallel machines are now available to solve significant problems for the nation that have been heretofore inaccessible. However, these machines, with their large memories are of little use for these problems without existing in an environment in which the scientist can perceive what is happening in the calculation and analyze the results effectively. This requires being able to transmit enormous amounts

of data from these machines through very high performance networks in a way which is easily comprehended and manipulated by the scientist. In order to provide such an environment for these Grand Challenge applications, researchers in the Advanced Computing Laboratory have been developing a very high speed network (100 Mbytes/sec) based on the standard HIPPI protocol developed at Los Alamos. This is used to send data over a multiple crossbar network between supercomputers, high performance graphics machines, and high speed framebuffers. Examples of scientific problems being explored in this way will be given, including approaches to high speed archival data storage and interactive data exploration over these networks. DOE

N93-16066# Naval Postgraduate School, Monterey, CA.
A TOOL FOR AUTOMATED VALIDATION OF NETWORK PROTOCOLS M.S. Thesis
Matthew J. Rothlisberger 24 Sep. 1992 252 p
(AD-A256726) Avail: CASI HC A12/MF A03

This thesis introduces a program that analyzes network protocols using the Communicating Finite State Machines (CFSM) model and the System of Communicating Machines (SCM) model. A simple two machine implementation of CFSM model is initially explored. A number of simple protocols are demonstrated as a means to validate the automated tool (program). The second model implemented is that of SCM model. The SCM tool uses many of the same data structures designed in the CFSM program. The SCM program is validated with an analysis of widely used data link protocols. Both programs were done in the Ada language environment. GRA

N93-16119# Naval Academy, Annapolis, MD.
IMPLEMENTATION OF A PARALLEL STOCHASTIC SOLVING METHOD FOR LINEARLY CONSTRAINED CONCAVE GLOBAL OPTIMIZATION PROBLEMS USING PARALLEL COMPUTING Final Report, 1991 - 1992
Matthew F. McLaughlin 8 May 1992 98 p
(AD-A257112; USNA-TSPR-190) Avail: CASI HC A05/MF A02

A parallel stochastic algorithm is implemented for solving the linearly constrained concave global optimization problem. The algorithm uses a multistart technique which repeatedly employs two phases, the global phase and the local phase. The global phase creates a random search direction to find a vertex of the linearly constrained feasible region. The local phase begins from that vertex and solves for a local minimum. The algorithm repeats the global and local phases to find all the local minima. The algorithm was in FORTRAN on the Connection Machine CM-2 and Cray X-MP EA/464 supercomputers. Computational results are presented for more than 200 test problems in three categories: known problems from the literature, randomly generated concave quadratic problems, and randomly generated fixed-charge problems. The test problems from the literature were run on both the Cray X-MP and the CM-2 and resulted in an analysis of the stochastic algorithm's efficiency on each machine. Computational results from randomly generated quadratic and fixed-charge functions resulted in an examination of how particular characteristics affect the difficulty of the problem. Lastly, the stochastic algorithm's performance on the Cray X-MP was analyzed and modeled using the timing results for random concave quadratic function problems. GRA

N93-16272# Superconducting Super Collider Lab., Dallas, TX.
A PARALLEL IMPLEMENTATION OF PARTICLE TRACKING WITH SPACE CHARGE EFFECTS ON AN INTEL IPSC/860
L. C. Chang, G. Bourianoff, B. Cole, and S. Machida Aug. 1992 19 p
(Contract DE-AC35-89ER-40486)
(DE93-000460; SSCL-Preprint-581) Avail: CASI HC A03/MF A01

Particle-tracking simulation is one of the scientific applications that is well suited to parallel computations. At the Superconducting Super Collider, it has been theoretically and empirically demonstrated that particle tracking on a designed lattice can achieve very high parallel efficiency on a MIMD Intel iPSC/860 machine. The key to such success is the realization that the particles can be tracked independently without considering their interaction. The perfectly parallel nature of particle tracking is broken if the interaction effects between particles are included. The space charge introduces an electromagnetic force that will affect the motion of tracked particles in 3-D space. For accurate modeling of the beam dynamics with space charge effects, one needs to solve 3-D Maxwell field equations, usually by a particle-in-cell (PIC) algorithm. This will require each particle to communicate with its neighbor grids to compute the momentum changes at each time step. It is expected that the 3-D PIC method will degrade parallel efficiency of particle-tracking implementation on any parallel computer. An efficient scheme is described for implementing particle tracking with space charge effects on an INTEL iPSC/860 machine. Experimental results show that a parallel efficiency of 75 pct. can be obtained. DOE

N93-16388*# Contel Federal Systems, Inc., Chantilly, VA. Government Networks Group.
US COMPUTER RESEARCH NETWORKS: DOMESTIC AND INTERNATIONAL TELECOMMUNICATIONS CAPACITY REQUIREMENTS
D. Kratochvil and D. Sood Dec. 1990 263 p
(Contract NAS3-25083)
(NASA-CR-191666; NAS 1.26:191666) Avail: CASI HC A12/MF A03

The future telecommunications capacity and connectivity requirements of the United States (US) research and development (R&D) community raise two concerns. First, would there be adequate privately-owned communications capacity to meet the ever-increasing requirements of the US R&D community for domestic and international connectivity? Second, is the method of piecemeal implementation of communications facilities by individual researchers cost effective when viewed from an integrated perspective? To address the capacity issue, Contel recently completed a study for NASA identifying the current domestic R&D telecommunications capacity and connectivity requirements, and projecting the same to the years 1991, 1996, 2000, and 2010. The work reported here extends the scope of an earlier study by factoring in the impact of international connectivity requirements on capacity and connectivity forecasts. Most researchers in foreign countries, as is the case with US researchers, rely on regional, national or continent-wide networks to collaborate with each other, and their US counterparts. The US researchers' international connectivity requirements, therefore, stem from the need to link the US domestic research networks to foreign research networks. The number of links and, more importantly, the speeds of links are invariably determined by the characteristics of the networks being linked. The major thrust of this study, therefore, was to identify and characterize the foreign research networks, to quantify the current status of their connectivity to the US networks, and to project growth in the connectivity requirements to years 1991, 1996, 2000, and 2010 so that a composite picture of the US research networks in the same years could be forecasted. The current (1990) US integrated research network, and its connectivity to foreign research networks is shown. As an example of projections, the same for the year 2010 is shown. Author

N93-16430# Illinois Univ., Urbana. Coordinated Science Lab.
COMPILER ASSISTED RECOVERY FOR FAULT-TOLERANT HIGHLY PARALLEL MULTIPROCESSOR ARCHITECTURES Final Report
W. K. Fuchs and Wen-Mei Hwu Aug. 1992 5 p
(Contract N00014-88-K-0656)
(AD-A256942) Avail: CASI HC A01/MF A01

The purpose was to develop and implement compiler assisted strategies for recovery through multiple instruction reexecution (rollback) in highly parallel computer architectures utilizing hierarchical shared memories. The goal was to facilitate very rapid recovery from high rates of transient and intermittent failures in SDI environments. We worked to achieve this goal with minimal impact on system performance and little hardware overhead by exploiting the hardware features already present in recently developed high performance processor architectures. Our objective was to demonstrate that through appropriate compilation techniques these hardware features can be used to perform rapid recovery, without significant architecture redesign. Our research effort concentrated on multiprocessor machines with hierarchical memory structures, due to the architectural trend toward hierarchical memory, shared variable, multiprocessor architectures and due to the current lack of understanding as to how rapid recovery can be accomplished in this class of machines. GRA

N93-16434# Purdue Univ., West Lafayette, IN. Dept. of Computer Sciences.
ADVANCED PARALLEL SYSTEMS Final Report, May 1990 - Sep. 1991
John R. Rice 21 Aug. 1992 5 p
(Contract DAAL03-90-G-0107)
(AD-A256958; ARO-27392.1-MA-SDI) Avail: CASI HC A01/MF A01

The objective was to explore algorithms and their implementation for

future advanced parallel systems. These systems are assumed to have hundreds or even thousands of processors and to be able to concentrate their computing power on one or a small number of tasks. Three principal questions were explored (1) the algorithms for the crucial applications which have enough parallelism to allow the power of the advanced parallel systems to be fully exploited, (2) the languages and implementation tools are needed for efficient programming of the algorithms, and (3) the relative performances of different algorithm types, of different architecture types, and of different implementation languages. The principal problem is stated for four areas and then the papers, conference presentations, theses and technical reports are listed for each area: (1) Analysis of the Performance of Future Computations; (2) Benchmarking Existing Computations; (3) Control of Parallel Computations; and (4) Parallel Algorithms for Physical Problems. GRA

N93-16565# Technische Univ., Delft (Netherlands). Computer Architecture and Digital Techniques Lab.

PARALLEL PROCESSING FOR LINEAR PROGRAMMING Ph.D. Thesis

Jian Luo 1992 271 p

(ISBN-90-6275-754-5; ETN-92-92793) Copyright Avail: CASI HC A12/MF A03

The parallel implementation of the simplex algorithm is presented. Simplex algorithm and the primal dual interior point algorithm are derived by using the logarithmic barrier function for solving practical linear programming problems. The original projective algorithm of Karmarkar is discussed, with respect to its possible parallel implementation. Performances of the implementations are studied and experimental results are shown. A number of useful software tools developed for solving linear programming problems are covered. The basic hardware systems for experimentation are networks of T8200 transputers. Introductory information on linear programming and parallel processing is given. Different algorithms are described in order to elaborate linear programming in mathematical terms. The transputer and the parallel processing programming language OCCAM are presented. The parallel implementation of the algorithms is carried out by executing them in the transputer networks. The tools developed during the study are reviewed. ESA

N93-16988# Sandia National Labs., Albuquerque, NM.

THE PERFORMANCE OF PAGOSA ON SEVERAL SIMD AND MIMD PARALLEL COMPUTERS

D. R. Gardner, D. D. Cline, C. T. Vaughan, R. Krall (Thinking Machines Corp., Cambridge, MA.), and M. Lewitt (nCUBE Corp., Foster City, CA.) Oct. 1992 48 p

(Contract DE-AC04-76DP-00789)

(DE93-002599; SAND-92-1452) Avail: CASI (US Sales Only)

The performance of a single-material version of the PAGO SA code has been measured on various parallel computers. The single-material version of PAGOSA is a three-dimensional, explicit, Eulerian hydrocode for modeling the high-speed hydrodynamic flow of an ideal gas, and was developed at Los Alamos National Laboratory for the Connection Machine-2 (CM-2) massively parallel computer. The performance of the original data-parallel version has been measured on two SIMD machines, the CM-2 and the CM-5, and the performance of a message-passing version developed by Sandia has been measured on five MIMD machines: the Cray Y-MP, the nCUBE 2, the Intel iPSC/860, the Intel Touchstone DELTA, and the CM-5. No special efforts were made to optimize the codes for any particular machine, except that the version Of PAGOSA run on the CM-2 and CM-5 in data-parallel mode is written in CM Fortran; the message-passing version is written in Fortran 77. The scaled speedup results, thus, show the performance that can be achieved for complex and realistic applications when they are first implemented on parallel computers. Separate measurements of communication and computation time on the nCUBE 2, the iPSC/ 8 60, the DELTA, and the CM-5 (message-passing mode) reveal whether these machines are limited by the speed of the communication network or the processor speed. DOE

N93-17028*# Santa Clara Univ., CA.

PARALLEL PROCESSING FOR SCIENTIFIC COMPUTATIONS Progress Report

Hasan S. AlKhatib 15 Jun. 1991 18 p

(Contract NCC2-644)

(NASA-CR-191910; NAS 1.26:191910) Avail: CASI HC A03/MF A01

The main contribution of the effort in the last two years is the introduction of the MOPPS system. After doing extensive literature search, we introduced the system which is described next. MOPPS employs a new solution to the problem of managing programs which solve scientific and engineering applications on a distributed processing environment. Autonomous computers cooperate efficiently in solving large scientific problems with this solution. MOPPS has the advantage of not assuming the presence of any particular network topology or configuration, computer architecture, or operating system. It imposes little overhead on network and processor resources while efficiently managing programs concurrently. The core of MOPPS is an intelligent program manager that builds a knowledge base of the execution performance of the parallel programs it is managing under various conditions. The manager applies this knowledge to improve the performance of future runs. The program manager learns from experience. Author

N93-17207# Lawrence Livermore National Lab., CA.

PDDP: A PARALLEL DATA DISTRIBUTION PREPROCESSOR

K. H. Warren Jul. 1992 25 p Presented at the 26th Hawaiian International Conference on System Science: Biotechnology Computing Track, Kauai, HI, 5-8 Jan. 1993

(Contract W-7405-eng-48)

(DE92-040400; UCRL-JC-111428; CONF-930117-4) Avail: CASI HC A03/MF A01

The current goal of the computer hardware industry is to produce computers featuring hundreds, even thousands of processors, that achieve Teraflop results. When such a massive number of processors are used, data proximity becomes a key concern. Existing mature software will not produce Teraflop levels on the new architecture. PDDP, a Fortran preprocessor under development at LLNL, is directed to a massively parallel machine that features loosely coupled distributed shared memory and that offers the convenience of programming a shared virtual address space. PDDP distributes shared data among processors in a semi-automatic manner. The distributed data is then treated in parallel by the processors. We say semi-automatic because PDDP makes uses of FORTRAN 90 array syntax and a Fortran D method of distribution to achieve this parallelization. Synchronization is handled by PFP, a split-join model that uses the team concept of parallel computing and is the target model for PDDP. The BBN TC2000 computer is the developmental platform for PDDP. The TC2000 has 128 processors, each with its own local memory, cache, and a contribution to the shared memory. DOE

N93-17385# Los Alamos National Lab., NM.

NADIR: A PROTOTYPE SYSTEM FOR DETECTING NETWORK AND FILE SYSTEM ABUSE

J. G. Hochberg, K. A. Jackson, C. A. Stallings, J. F. McClary, D. H. DuBois, and J. R. Ford 1992 22 p Presented at the 7th European Conference on Information Systems Security, Audit, and Control, Brussels (Belgium), 16-18 Nov. 1992

(Contract W-7405-eng-36)

(DE93-000861; LA-UR-92-3214; CONF-9211108-1) Avail: CASI HC A03/MF A01

This paper describes the design of a prototype computer misuse detection system for the Los Alamos National Laboratory's Integrated Computing Network (ICN). This automated expert system, the Network Anomaly Detection and Intrusion Reporter (NADIR), streamlines and supplements the manual audit record review traditionally performed by security auditors. NADIR compares network activity, as summarized in weekly profiles of individual users and the ICN as a whole, against expert rules that define security policy, improper or suspicious behavior, and normal user activity. NADIR reports suspicious behavior to security auditors and provides tools to aid in follow-up investigations. This paper describes analysis by NADIR of two types of ICN activity: user authentication and access control, and mass file storage. It highlights system design issues of data handling, exploiting existing auditing systems, and performing audit analysis at the network level. DOE

N93-17545# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.

PARALLEL STEP-BY-STEP METHODS

P. J. vanderHouwen Sep. 1991 13 p

(CWI-NM-R9116; ETN-92-92502) Copyright Avail: CASI HC A03/MF A01

Recent research in step by step methods for solving Initial Value Problems (IVPs) on parallel computers is reviewed. Explicit step by step methods for nonstiff first order IVPs are surveyed: explicit block methods, predictor-corrector iteration, Runge-Kutta correctors, and Richardson extrapolation. These techniques result in parallel methods in which the parallelism is called 'parallelism across the method'. Methods possessing this form of parallelism can already profit from parallel architectures in the case of scalar IVPs. Parallel step by step methods that are suitable for integrating stiff first order IVPs are considered. Such methods are necessarily implicit. However, all methods discussed require the solution of systems whose dimension does not exceed the dimension of the IVP. The methods are respectively based on: diagonally implicit block by block calculations, diagonally implicit iteration, and on local Richardson extrapolation of the implicit Euler method and of the trapezoidal rule. ESA

N93-17549# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
PARALLEL-ITERATED RUNGE-KUTTA METHODS FOR STIFF ORDINARY DIFFERENTIAL EQUATIONS
B. P. Sommeijer Oct. 1991 22 p
(CWI-NM-R9117; ETN-92-92503) Copyright Avail: CASI HC A03/MF A01

Algorithms that are suitable in a parallel environment were constructed. Attention was focused on numerical methods for the initial value problem. An iterative approach to solve the stage vector equations occurring in a fully implicit Runge-Kutta method was proposed. By a suitable choice of the iteration parameters, the resulting scheme can be cast into the class of A-stable Diagonally Implicit Runge-Kutta (DIRK) methods. However, the new scenes can be given a much higher order than the classical DIRK's available in the literature. The iterated methods have the special feature that many of the implicit relations can be solved in parallel, which offers a great computational advantage. Moreover, because of the 'DIRK-nature' of the new schemes, they require only one LU-factorization (of a matrix with the Ordinary Differential Equation (ODE) dimension) per step (per processor). Two different iteration strategies are discussed and, for both strategies, optimal iteration parameters are derived. For both approaches a variable stepsize code was implemented on an ALLIANT FX/4 computer. On the basis of two test problems, the speedup factors were measured; these factors, which depend on the dimension of the ODE, vary between 2.5 and 3.7 which is pretty close to the 'ideal' factor 4 on this machine. The performance of the codes is compared with that of the best sequential stiff ODE codes: SIMPLE, LSODE and RADAU5. For a relatively simple ODE of small dimension, the parallel code is slightly more efficient than LSODE, and much more efficient than SIMPLE. For a more difficult problem of a large dimension (15 ODE's), the parallel code needs considerably less time than the sequential codes. ESA

N93-17724# Naval Postgraduate School, Monterey, CA.
STATIC SCHEDULER FOR HARD REAL-TIME TASKS ON MULTIPROCESSOR SYSTEMS M.S. Thesis
Tzu-Chiang Chang Sep. 1992 148 p
(AD-A257663) Avail: CASI HC A07/MF A02

Task scheduling is one of the most important issues in a hard real-time system, because it is the schedule that ensures the tasks meet their deadlines and precedence constraints. Given a set of hard real-time tasks, to determine whether a feasible schedule exists such that the timing constraints and precedence constraints of the tasks are satisfied, and to produce such a schedule if one exists are the purposes of a static scheduler. The previous work done for the static scheduler in the computer aided prototyping system (CAPS) was mainly for the single processor environment. The major work of this thesis is to develop several algorithms for scheduling hard real-time tasks on multiprocessor systems so that the associated timing and precedence constraints, as well as the communication requirements are met under the worst-case situation. GRA

N93-17731# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
GENERALIZED STEADY-STATE: A SYSTEM CONCEPT IN SIMULATION
L. Dekker 1992 14 p
(Rept-92-25; ETN-93-93119) Copyright Avail: CASI HC A03/MF A01

The concept 'generalized steady state' is introduced for differential systems as a generalization of the known concepts 'steady state' and 'periodic steady state' arising in two special cases: a constant and a periodic input signal. Several formulations and interpretations of the generalized steady state are elucidated. For time independent linear systems, the generalized steady state can be defined by the property that its Laplace transform has no poles coinciding with the eigenvalues of the system. For stable and strictly unstable time independent and time dependent linear systems, the generalized steady state can be formulated in the time domain as an improper time integral of the input signal. The most general definition applicable to both linear and nonlinear systems is based upon minimization of the total system energy from the very past to the very future. For some one, two, and three dimensional distributed parameter systems, a formulation of the generalized steady state is formulated as an infinite series of time derivatives of the 'boundary' input signals. These series expansions can be of use in massively parallel simulation. ESA

N93-17738# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 1: Architectures Paralleles, Bases de Donnees, Reseaux et Systemes Distribues.
PARALLEL SIMULATION OF STOCHASTIC PETRI NETS USING RECURSIVE EQUATIONS
Francois Baccelli and Miguel Canales Sep. 1991 23 p
(INRIA-RR-1520; ETN-93-93371) Avail: CASI HC A03/MF A01

A parallel simulation method for the class of stochastic decision free Petri nets, that is amenable to an SIMD implementation is proposed. This method is based on the max, plus or minus linear structure of recursive equations that were established for this type of system. Two variants are analyzed, the spatial and the temporal methods. The spatial method allows simulation of large networks. The temporal method, which generalizes to Petri nets a method that was introduced recently for queues, is of more use for simulating systems for a long interval. The emphasis is put on the spatial approach which is shown to provide a simple way of estimating both the cycle time and the statistics of the marking process. The theoretical complexity of this algorithm is investigated. In particular, a few examples of practical interest are provided (blocking queues in tandem and a stochastic job shop model) for which the cost of simulating O(NT) events of a net of size T is in O(N log T) with this parallel simulation method, while the classical sequential discrete event simulation is in O(NT) at least. These theoretical considerations are confirmed by experimental results obtained from a prototype that was implemented on the Connection Machine. ESA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N93-15687# Naval Postgraduate School, Monterey, CA.
NONLINEAR ADAPTIVE CONTROL USING BACKPROPAGATING NEURAL NETWORKS M.S. Thesis
Kurt W. Menke Jun. 1992 58 p
(AD-A256828) Avail: CASI HC A04/MF A01

The objective of this research is to develop a nonlinear regulator for an adaptive control system using backpropagating neural networks (BNN's) in conjunction with a linear quadratic regulator (LQR). The basic concepts of adaptive control and the structure of neural networks are discussed. These concepts are integrated and the nonlinear regulator is derived. Simulation is conducted on a representative nonlinear system with both the LQR and the nonlinear regulator. Training of the regulator and its performance under varying BNN parameter values are examined. The simulation results show that the nonlinear regulator with BNN's exhibits superior performance compared to the LQR when the nonlinearities are large. The optimization of regulator performance with regard to BNN parameter values is discussed. Further research is required in order to determine the general applicability of this regulator and to develop more specific guidelines for BNN parameters. GRA

N93-15815# Maryland Univ., College Park. Dept. of Computer Science.
INTEGRATING NEURAL NETWORK AND EXPERT REASONING: AN EXAMPLE Final Technical Report

James Hendler and Leonard Dickens 1991 10 p
(Contract N00014-88-K-0560; NSF IRI-89-07890)
(AD-A257215) Avail: CASI HC A02/MF A01

In this paper, we describe a shell which has been developed to allow an integration of neural network and expert systems technology. The system, SCRuFFy, is based on an analysis of the different abilities and time courses of NN and AI systems. Critical to the processing of this system is a temporal pattern matcher which is used to mediate between the two subsystems, providing a signal to symbol mapping. This mapping allows the expert system to reason about the time course of signals which are classified by a connectionist network which is trained via classical back-propagation of error during a separate training phase. An example of the simulated control of the temperature of an underwater welding robot is presented to demonstrate these capabilities. GRA

N93-15876# Naval Postgraduate School, Monterey, CA.
GENETIC ALGORITHMS FOR THE DEVELOPMENT OF REAL-TIME MULTI-HEURISTIC SEARCH STRATEGIES M.S. Thesis
Gary B. Parker Sep. 1992 131 p
(AD-A257454) Avail: CASI HC A07/MF A02

Search of an unknown space by a physical agent (such as an autonomous vehicle) is unique in search as the customarily most important goal (to reduce the computation time required to obtain the shortest distance) is not as important as minimal movement. There is a real-time aspect since the agent is actually moving; using energy each step of the way. Having limited energy resources and knowledge of the terrain (only adjacent nodes), the key factor for the physical agent's search algorithm is reduction of steps. Hence, any heuristic that can help keep step count to a minimum must be considered. Korf and Shing addressed this issue in separate works. Both made use of known information about the frontier node's distance from the current node in addition to a heuristic estimating the distance from goal. Herein, a simple genetics based method is presented which produces adaptive, efficient multi-heuristic search strategies for the real time problem. Extensive empirical study shows that this approach produced search strategies with much better performance over existing search algorithms for most terrain types. The methodologies used to develop these improved strategies for our specific case, are also applicable to a multitude of real-time search/optimization problems in the general case. GRA

N93-15933# Army Signals Warfare Lab., Vint Hill Farms Station, VA.
USING AN ASSUMPTION-BASED TRUTH MAINTENANCE SYSTEM TO SWITCH CONTEXTS DURING DATA FUSION PROCESSING
T. Cronin 1991 23 p
(AD-A256123; CSWD-92-TRF-0040) Avail: CASI HC A03/MF A01

This report is organized into seven sections. The first deals with issues raised by the effect of time on discrete event modeling, and is known as the frame problem. The second section describes a classical control theory approach to multiple target tracking, which relies exclusively upon Bayes theorem and a Kalman filter to track objects which change spatial position over time. The third section on justification-based truth maintenance systems introduces the concept of retraction to correct temporal inconsistencies which arise in situation databases when objects change spatial position. The fourth section on assumption-based truth maintenance system is reactionary to the third, in that it proposes to relieve the computational burden of retraction by pursuing several feasible hypotheses in parallel. The fifth section, the problem of uncertainty in data fusion and the implication for logic-seeking truth maintenance technology is discussed. The sixth section describes some Army work which can provide real-time collateral inputs to Reid's target tracker, and also to the two styles of truth maintenance philosophy. The final section proposes a handshaking protocol to interface Reid's statistical system to a logic-driven truth maintenance system. GRA

N93-15934# Physics and Electronics Lab. TNO, The Hague (Netherlands).
PROJECT PROPOSAL ACTIVE VISION Final Report
P. F. Krekel May 1992 37 p In DUTCH
(AD-A256490; FEL-92-B104; TNO-TD92-1437) Avail: CASI HC A03/MF A01

The goal of computer vision is to construct automatically, by analyzing 2-dimensional images, a symbolic interpretation that describes the environment from which the images are captured. Via numerous intermediate descriptions at a symbolic level, the vision system finally generates a semantic world model that provides the interpretation of the scene. This interpretation can serve as an input for a higher level process such as path planning or collision avoidance. In this respect, computer vision can be considered as a feature extractor process, like is the case for identification and classification systems. Though the feature space, which is in the computer vision context denoted as world model, is very different from nature for all these systems, they have the same need to identify objects. This implies that vision systems must have access to a knowledge base containing descriptions of objects or generalized object classes. Many concepts in the field of computer vision are generic within the context of autonomous systems and can be transformed to other applications: the development of a powerful computer vision system depends on the successful integration of sensor, sensor preprocessing, signal analysis, and artificial intelligence techniques. Therefore, the main challenge in this project is to bridge the analytic world of signal processing and the symbolic world of artificial intelligence. GRA

N93-16006# Naval Weapons Center, China Lake, CA.
LOW SENSITIVITY INTERPOLATION USING FEED-FORWARD NEURAL NETWORKS WITH ONE HIDDEN LAYER Final Report, Oct. 1990 - Oct. 1991
Jorge M. Martin Dec. 1991 42 p
(NR Proj. RR0-1405; NR Proj. RR0-5202)
(AD-A257306; NWC-TP-7191) Avail: CASI HC A03/MF A01

It is possible to assign directly the weights of a feed-forward neural net with one hidden layer so that the network interpolates through a given set of input-output points exactly and in such a way that the sensitivity to noise at the points of interpolation is as small as desired. This is demonstrated with a constructive proof. The weight assignment for exact interpolation requires the inversion of a nonsingular matrix. If the exact interpolation requirement is relaxed, then the inversion of that matrix can be avoided. It is possible to determine weights so that the network approximately interpolates through the set of points with any desired degree of accuracy and with a sensitivity as small as desired. Both the accuracy of interpolation and the sensitivity to noise are controlled by the size of the weights in the first layer of weights. Estimates on how large these weights have to be to achieve a desired interpolation accuracy and noise sensitivity are derived. An algorithm for approximate interpolation with low sensitivity is presented and illustrated with simple examples. GRA

N93-16008# Rome Lab., Griffiss AFB, NY.
SPACECRAFT COMMAND AND CONTROL USING AI PLANNING TECHNIQUES. THE O-PLAN2 PROJECT Final Report, Jun. 1989 - May 1992
Austin Tate, Brian Drabble, and Richard Kirby Aug. 1992 73 p
(Contract F49620-89-C-0081)
(AD-A257395; AIAI-TR-109; RL-TR-92-217) Avail: CASI HC A04/MF A01

O-Plan2 (the Open Planning Architecture) provides a generic domain independent computational architecture suitable for command, planning and execution applications. The main contribution of the O-Plan2 research has been a complete vision of a modular and flexible planning and control system incorporating artificial intelligence methods. This report describes the O-Plan2 agent oriented architecture and describes the communication which takes place between planning and execution monitoring agents built upon the architecture. Separate modules of such a system are identified along with internal and external interface specifications that form a part of the design. A description of the prototype implementation of O-Plan2 is included and the report describes an application of O-Plan2 to the generation of on-board commands for a simple, built realistic, spacecraft. GRA

N93-16039# Naval Underwater Systems Center, New London, CT.
STUDIES IN BEAMFORMING TRACKING NEURAL NETWORKS MATHEMATICS
R. L. Streit 1991 513 p
(AD-A255574) Avail: CASI HC A22/MF A04

The four parts of this collection of technical articles, reports, and memoranda deal with beamforming studies (12 papers), frequency line detector/trackers (9 papers), artificial neural networks (3 papers), and

mathematical studies (10 papers). The content of these 34 papers is discussed in the forward provided for each part of this collection. GRA

N93-16256# Duke Univ., Durham, NC. School of Engineering.
PARAMETER IDENTIFICATION AND ADAPTIVE CONTROL OF COOPERATING ROBOTS Final Report, 1 Jan. 1989 - 30 Jun. 1992
Devendra P. Garg Sep. 1992 22 p
(Contract DAAL03-89-K-0020)
(AD-A256984; DU-RAMAL-1992-9; ARO-25409.11-EG) Avail: CASI HC A03/MF A01

The dynamics and control problems related to open and closed chain robotic systems were studied. The aspects are studied of load sharing and internal force control in case of closed chain manipulation which has been generally ignored thus far in current literature. This research demonstrates a practical solution to dual-arm continuous control problem for heavy link industrial manipulators such as IBM 7540. Integration of vision and force sensors in dual- arm workcells is also described. Analytical and empirical solutions using pseudo-inverse and back error propagation are developed. Insightful study of back error propagation indicates the relationship of neural algorithms to nonlinear least squares fit and established notions in estimation theory. An approach to camera-calibration and vision guided robot path-tracking is also advanced. Detailed results and discussions are included in the publications cited in the report. GRA

N93-16275# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
MODELLING DYNAMICAL SYSTEMS WITH EQUALITY STATE-SPACE CONSTRAINTS
A. A. tenDam 1 Jul. 1990 75 p
(NLR-TP-89418-U; ETN-93-92857) Avail: CASI HC A04/MF A01

A mathematical theory for modeling dynamical systems with equality state space constraints is presented. The dynamic behavior of these systems is represented by a combination of differential and algebraic equations. It is shown that the freedom offered by control is essential to obtain other, mathematically equivalent formulations. The notion of applicable control is introduced. A characterization for all applicable controls of constrained dynamical systems is presented. The theory covers the case of mechanical systems with equality state space constraints. The equations of motions can be obtained by a choice of parameters or by restrictions on the class of applicable controls. It is shown that in the case of mechanical systems, holonomic and nonholonomic constraints are special cases. The theory is illustrated by modeling constrained manipulator motions. The kinematic relation between joints and end effector is treated. Test cases are considered. Decomposition of a model on submodels as well as easy exchange of submodels is supported by the theory. The models derived can form the basis of the development of planning and (feedback) control schemes for dynamical systems subject to equality state space constraints. ESA

N93-16291# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
EQUIVALENT FLEXIBILITY MODELLING FOR THE RECURSIVE SIMULATION OF ROBOT MANIPULATOR DYNAMICS
P. T. L. M. vanWoerkom 14 Dec. 1989 185 p
(Contract NIVR-02506-N)
(NLR-TP-89076-U; ETN-93-92853) Avail: CASI HC A09/MF A02

The mathematical modeling of the dynamics of spacecraft based manipulators displaying structural flexibility in their links is presented. The equations of motion must be cast in a form suitable for efficient numerical simulation. The mathematical model for each single flexible link is presented. It consists of an equivalent flexible model which can be interpreted as consisting of a chain of rigid sublinks, connected by fictitious joints, and acted upon by fictitious forces and torques in addition to the real forces and torques. The transformation allows the reuse of existing recursive rigid body simulation software. The method of equivalent flexibility modeling uses structural flexibility data for each link separately. Several test cases are investigated. The numerical errors observed are found to be of the order of computational accuracy. ESA

N93-16355# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
REDHEFFER'S LEMMA AND H(INFINITY)-CONTROL OR INFINITE-DIMENSIONAL SYSTEMS
Bert vanKeulen 1992 24 p
(W-9206; ETN-93-92836) Avail: CASI HC A03/MF A01

An infinite dimensional version of a lemma is proven to be crucial in the theory of H(infinity) control with measurement feedback for finite dimensional systems. The result is a generalization of a finite dimensional result. The proof depends solely on time domain techniques so that it should be possible to prove a time varying or nonlinear version of the result. Using this result, a derivation of the parameterization is given of all controllers that solve the suboptimal regular H(infinity) control problem with measurement feedback for a large class of infinite dimensional systems, thereby generalizing the finite dimensional result. ESA

N93-16387*# North Carolina State Univ., Raleigh. Mars Mission Research Center.
TELEROBOTIC CONTROL OF A MOBILE COORDINATED ROBOTIC SERVER Interim Technical Report
Gordon Lee 1991 97 p
(Grant NAG1-1283)
(NASA-CR-191650; NAS 1.26:191650) Avail: CASI HC A05/MF A02

Results from the Master's Degree Thesis of Mr. Robert Stanley, a graduate student supervised by the principal investigator on this project is reported. The goal of this effort is to develop advanced control methods for flexible space manipulator systems. As such, a fuzzy logic controller has been developed in which model structure as well as parameter constraints are not required for compensation. A general rule base is formulated using quantized linguistic terms; it is then augmented to a traditional integral control. The resulting hybrid fuzzy controller stabilizes the structure over a broad range of uncertainties, including unknown initial conditions. An off-line tuning approach using phase portraits gives further insight into the algorithm. The approach was applied to a three-degree-of-freedom manipulator system - the prototype of the coordinated flexible manipulator system currently being designed and built at North Carolina State University. Author

N93-16474# Universiteit Twente, Enschede (Netherlands).
DYNAMIC FEEDBACK IN NONLINEAR SYNTHESIS PROBLEMS Ph.D. Thesis
Hendrikus Jacobus Co Huijberts 1992 190 p
(ISBN-90-9004142-7; ETN-92-92820) Avail: CASI HC A09/MF A02

The purpose of the work is to explain the role of dynamic and static state feedback in the solution of synthesis problems for linear control systems. Particular attention is given to the disturbance decoupling problem, the model matching problem, and the input-output decoupling problem. The main concepts of the differential geometry, which primarily concern the basic tool applied, are reviewed. The theory on the linear and nonlinear disturbance decoupling problem via static state feedback is presented. The theory is applied to a strong input-output decoupling problem via regular static feedback. The problem of disturbance decoupling via regular dynamic state feedback is solved. The notion of an invariant subspace for a linear system was generalized to nonlinear systems via the notion of a locally invariant distribution. The disturbance decoupling problem via nonregular dynamic state feedback and disturbance decoupling problem via nonregular dynamic state feedback and disturbance measurements are formulated. The formulation of the nonlinear matching problem is given. The Hamiltonian control systems are introduced. ESA

N93-16490# Technische Univ., Delft (Netherlands).
TOPGENE: AN ARTIFICIAL INTELLIGENCE APPROACH TO A DESIGN PROCESS Ph.D. Thesis
Abolfazl Zandi-Nia 1992 413 p Sponsored by Ministry of Higher Education and A.T. Univ.
(ISBN-90-9004900-2; ETN-92-92790) Avail: CASI HC A18/MF A04

An attempt towards the automatic generation of architectural designs at the abstract topological level is developed. The work was targeted for a knowledge based system. Close examination of the problem, the domain knowledge, and the knowledge based technology, showed that a deep reasoning approach based on mathematical modeling is more realistic and more fruitful than a pure knowledge based approach. The system developed on this basis is called TOPGENE, standing for the Topological Pattern Generator. TOPGENE uses mathematical modeling and heuristic knowledge of the domain to generate connectivity patterns of buildings. TOPGENE,

by integrating heuristics and mathematical modeling, takes advantage of both methods. Definitions and characteristics of design and models are reviewed. Problem solving methods in artificial intelligence are summarized. Means for diagnosing the structural complexity of systems having a topological property representable as a graph are summarized. Issues involved in the implementation of TOPGENE as a system are described. Experiments carried out with TOPGENE are presented. A neural model of a specific type of architectural design problem, the testing of TOPGENE, and further work are discussed. ESA

N93-16515# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Abteilung Steuerung and Regelung.
A CONTRIBUTION TO THE DYNAMIC FEEDFORWARD OPEN LOOP CONTROL OF MULTIVARIABLE SYSTEMS AND TO THE OPTIMAL DESIGN OF COMMAND FUNCTIONS [EIN BEITRAG ZUR DYNAMISCHEN VORSTEUERUNG VON MEHRGROEBENSYSTEMEN UND ZUR OPTIMALEN GESTALTUNG VON FUEHRUNGSFUNKTIONEN]
Hagen Leyendecker Feb. 1992 67 p In GERMAN
(DLR-FB-92-05; ETN-93-92401) Avail: CASI HC A04/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The analysis of the dynamic feedforward open loop control system realized by the model of the plant gives information about the conditions of the command functions to fulfilled so that the plant can follow these commands without return difference. Unstable eigenvalues of the feedforward open loop controller are not acceptable. They have to be compensated by nominator zeros of the transfer functions of the command inputs. Two examples and flight test results of a maneuver demand system for the BO-105 helicopter show the efficiency of the control concept in practice. ESA

N93-16571# Universiteit Twente, Enschede (Netherlands).
A DESIGN TOOL FOR ELECTROMECHANICAL SERVO SYSTEMS Ph.D. Thesis
Herman Groenhuis 1991 126 p
(ISBN-90-9004089-7; ETN-92-92823) Avail: CASI HC A07/MF A02

The development of a design tool for electromechanical position servo systems including one dominant mechanical compliance is described. Three realistic feedback concepts were selected: velocity and position taken from the actuator, velocity feedback for the actuator, position, feeback from the end effector, and velocity and position taken from the end effector. Criteria for optimum feedback of velocity and position to ensure maximum dynamic positional accuracy and incorporating a stability margin are discussed. The investigation concentrates on the positional error after the change in the input functions. A mathematical model is developed, and the achievable positional accuracy for the three feedback concepts and various kinds of input function are established. The required gain for the velocity and position loop is calculated. The influence of damping in the mechanism on the positional accuracy is investigated. Additional control strategies are discussed. The optimum servo parameter settings and the achievable positional accuracy are verified. Both simulations and measurements resulted in a design tool which can be applied by a non expert user. The possibility to apply the fourth order design tool for higher order electromechanical servo systems is considered. ESA

N93-16604# Los Alamos National Lab., NM.
BACK PROPAGATION NEURAL NETWORKS FOR FACIAL VERIFICATION
A. E. Garnett, ed. Oct. 1992 60 p
(Contract W-7405-eng-36)
(DE93-001428; LA-12353-MS) Avail: CASI HC A04/MF A01

We conducted a test to determine the aptitude of neural networks to recognize human faces. The pictures we collected of 511 subjects captured both profiles and many natural expressions. Some of the subjects were wearing glasses, sunglasses, or hats in some of the pictures. The images were compressed by a factor of 100 and converted into image vectors of 1400 pixels. The image vectors were fed into a back propagation neural network with one hidden layer and one output node. The networks were trained to recognize one target person and to reject all other persons. Neural networks for 37 target subjects were trained with 8 different training sets that consisted of different subsets of the data. The networks were then tested on the rest of the data, which consisted of 7000 or more unseen pictures. Results indicate that a false acceptance rate of less than 1 percent can be obtained, and a false rejection rate of 2 percent can be obtained when certain restrictions are followed. DOE

N93-16622*# Rensselaer Polytechnic Inst., Troy, NY. Electrical, Computer, and Systems Engineering.
PATH PLANNING FOR ASSEMBLY OF STRUT-BASED STRUCTURES Thesis
Rolf Muenger May 1991 122 p
(Grant NAGw-1333)
(NASA-CR-191874; NAS 1.26:191874; CIRSSE-91) Avail: CASI HC A06/MF A02

A path planning method with collision avoidance for a general single chain nonredundant or redundant robot is proposed. Joint range boundary overruns are also avoided. The result is a sequence of joint vectors which are passed to a trajectory planner. A potential field algorithm in joint space computes incremental joint vectors delta-q = delta-q(sub a) + delta-q(sub c) + delta-q(sub r). Adding delta-q to the robot's current joint vector leads to the next step in the path. Delta-q(sub a) is obtained by computing the minimum norm solution of the underdetermined linear system J delta-q(sub a) = x(sub a) where x(sub a) is a translational and rotational force vector that attracts the robot to its goal position and orientation. J is the manipulator Jacobian. Delta-q(sub c) is a collision avoidance term encompassing collisions between the robot (links and payload) and obstacles in the environment as well as collisions among links and payload of the robot themselves. It is obtained in joint space directly. Delta-q(sub r) is a function of the current joint vector and avoids joint range overruns. A higher level discrete search over candidate safe positions is used to provide alternatives in case the potential field algorithm encounters a local minimum and thus fails to reach the goal. The best first search algorithm A* is used for graph search. Symmetry properties of the payload and equivalent rotations are exploited to further enlarge the number of alternatives passed to the potential field algorithm. Author

N93-16658*# Navtrol Co., Dallas, TX.
A TELEROBOTIC DIGITAL CONTROLLER SYSTEM Final Report, May 1989 - Sep. 1992
Richard J. Brown Oct. 1992 154 p
(Contract NAS5-30633; SBIR 05.01-3319)
(NASA-CR-191799; NAS 1.26:191799) Avail: CASI HC A08/MF A02

This system is a network of joint mounted dual axes digital servo-controllers (DDSC), providing control of various joints and end effectors of different robotic systems. This report provides description of and user required information for the Digital Controller System Network (DSCN) and, in particular, the DDSC, Model DDSC-2, developed to perform the controller functions. The DDSC can control 3 phase brushless or brush type DC motors, requiring up to 8 amps. Only four wires, two for power and 2 for serial communication, are required, except for local sensor and motor connections. This highly capable, very flexible, programmable servo-controller, contained on a single, compact printed circuit board measuring only 4.5 x 5.1 inches, is applicable to control systems of all types from sub-arc second precision pointing to control of robotic joints and end effectors. This document concentrates on the robotic applications for the DDSC. Author

N93-16666# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
NEURAL-NETWORK ACCEPTORS
M. F. J. Drossaers Jun. 1992 71 p
(Memo-INF-92-36; ETN-92-92448) Copyright Avail: CASI HC A04/MF A01

The profitability of the use of neural networks for integrated linguistic analysis is addressed via a Hopfield model for syntactical analysis. A neural network as an implementation of a nondeterministic finite state acceptor, defined for a bounded push down automaton that can accept context free languages with limited center embedding, is proposed. The network's behavior can be predicted a priori, so the presented theory can be tested. The operation of the network as an implementation of the acceptor is probably correct. A solution of the problem of spurious states in Hopfield models is found: they are used as dynamically constructed reprensentations of states of the deterministic neural network acceptor

that is the result of mapping a nondeterministic finite state acceptor onto the network. ESA

N93-16708*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
PASSIVITY/LYAPUNOV BASED CONTROLLER DESIGN FOR TRAJECTORY TRACKING OF FLEXIBLE JOINT MANIPULATORS
Pierre Sicard, John T. Wen, and Leonardo Lanari (Rome Univ., Italy) Aug. 1992 55 p
(Grant NAGw-1333)
(NASA-CR-191852; NAS 1.26:191852; CIRSSE-121) Avail: CASI HC A04/MF A01

A passivity and Lyapunov based approach for the control design for the trajectory tracking problem of flexible joint robots is presented. The basic structure of the proposed controller is the sum of a model-based feedforward and a model-independent feedback. Feedforward selection and solution is analyzed for a general model for flexible joints, and for more specific and practical model structures. Passivity theory is used to design a motor state-based controller in order to input-output stabilize the error system formed by the feedforward. Observability conditions for asymptotic stability are stated and verified. In order to accommodate for modeling uncertainties and to allow for the implementation of a simplified feedforward compensation, the stability of the system is analyzed in presence of approximations in the feedforward by using a Lyapunov based robustness analysis. It is shown that under certain conditions, e.g., the desired trajectory is varying slowly enough, stability is maintained for various approximations of a canonical feedforward. Author

N93-16740*# Alabama Univ., Huntsville. Intelligent Systems Lab.
STUDY OF PORT OF FRAMES ARTIFICIAL INTELLIGENCE SYSTEM Final Report
Leslie D. Interrante, Nilda R. Romero, John S. Rogers, and Daniel M. Rochowiak 9 Dec. 1992 157 p
(Contract NAS8-38609)
(NASA-CR-191703; NAS 1.26:191703) Avail: CASI HC A08/MF A02

The Fault Recovery and Management Expert System (FRAMES) was analyzed to determine the issues involved in porting its functionality into each of the following three languages and/or shells: (1) Ada, a general-purpose programming language developed at the initiative of the US Department of Defense; (2) CLIPS, the C Language Integrated production System, and expert system shell, freely available to NASA and USAF and their contractors; and (3) G2, marketed by Gensym Corp., a tool for developing real-time intelligent monitoring and control systems. The features of each language were examined and compared to those of the current FRAMES platform (the LISP language on a Solbourne workstation). Structures for appropriate knowledge and data representation in each language were determined. The structures were compared to those which are currently employed in FRAMES. Issues including amount of programming, cost, degree of extensibility, and required degree of programming skill were addressed. The 6.x.x diagnosis rule group was ported. Author

N93-16951# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
NONLINEAR CONTROL PROBLEMS AND SYSTEMS APPROXIMATIONS: A GEOMETRIC APPROACH
A. C. Ruiz and H. Nijmeier Mar. 1992 9 p Presented at Nonlinear Control Design Symposium, Bordeaux, France, 1992 Submitted for publication Sponsored by CONACYT, Mexico
(MEMO-1039; ETN-92-92467) Avail: CASI HC A02/MF A01

A study which, given a nonlinear system, determines at an equilibrium point a relation between controlled invariant distributions defined for the nonlinear plant and any Taylor series approximation of it, is presented. When dealing with control problems whose solvability conditions are stated in terms of specific controlled invariant distributions, these relations enable a decision to be made as to whether the solvability of the control problem for the approximation and for the nonlinear system are equivalent. Some examples are given to illustrate the practical applicability of these results. ESA

N93-17056*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MEASURAND TRANSIENT SIGNAL SUPPRESSOR Patent Application
Richard J. Bozeman, Jr., inventor (to NASA) 2 Oct. 1992 17 p
(NASA-Case-MSC-22027-1; NAS 1.71:MSC-22027-1;
Patent-Appl-SN-955801) Avail: CASI HC A03/MF A01

A transient signal suppressor for use in a controls system which is adapted to respond to a change in a physical parameter whenever it crosses a predetermined threshold value in a selected direction of increasing or decreasing values with respect to the threshold value and is sustained for a selected discrete time interval is presented. The suppressor includes a sensor transducer for sensing the physical parameter and generating an electrical input signal whenever the sensed physical parameter crosses the threshold level in the selected direction. A manually operated switch is provided for adapting the suppressor to produce an output drive signal whenever the physical parameter crosses the threshold value in the selected direction of increasing or decreasing values. A time delay circuit is selectively adjustable for suppressing the transducer input signal for a preselected one of a plurality of available discrete suppression time and producing an output signal only if the input signal is sustained for a time greater than the selected suppression time. An electronic gate is coupled to receive the transducer input signal and the timer output signal and produce an output drive signal for energizing a control relay whenever the transducer input is a non-transient signal which is sustained beyond the selected time interval. NASA

N93-17275*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NEW KINEMATIC FUNCTIONS FOR REDUNDANCY RESOLUTION USING CONFIGURATION CONTROL Patent Application
Homayoun Seraji, inventor (to NASA) 27 Oct. 1992 54 p
(NASA-Case-NPO-18608-1-CU; NAS 1.71:NPO-18608-1-CU;
US-Patent-Appl-SN-967083) Avail: CASI HC A04/MF A01

The invention fulfills new goals for redundancy resolution based on manipulator dynamics and end-effector characteristics. These goals are accomplished by employing the recently developed configuration control approach. Redundancy resolution is achieved by controlling the joint inertia matrix of the end-effector mass matrix that affect the inertial torques, or by reducing the joint torques due to gravity loading and payload. The manipulator mechanical-advantage and velocity-ratio are also used as performance measures to be improved by proper utilization of redundancy. Furthermore, end-effector compliance, sensitivity, and impulsive force at impact are introduced as redundancy resolution criteria. The new goals for redundancy resolution allow a more efficient utilization of the redundant joints based on the desired task requirements. NASA

N93-17276*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NEURAL NETWORK TRAINING BY INTEGRATION OF ADJOINT SYSTEMS OF EQUATIONS FORWARD IN TIME Patent Application
Nikzad Toomarian, inventor (to NASA) and Jacob Barhen, inventor (to NASA) 27 Oct. 1992 31 p
(NASA-Case-NPO-18586-1-CU; NAS 1.71:NPO-18586-1-CU;
US-Patent-Appl-SN-969868) Avail: CASI HC A03/MF A01

A method and apparatus for supervised neural learning of time dependent trajectories exploits the concepts of adjoint operators to enable computation of the gradient of an objective functional with respect to the various parameters of the network architecture in a highly efficient manner. Specifically, it combines the advantage of dramatic reductions in computational complexity inherent in adjoint methods with the ability to solve two adjoint systems of equations together forward in time. Not only is a large amount of computation and storage saved, but the handling of real-time applications becomes also possible. The invention has been applied it to two examples of representative complexity which have recently been analyzed in the open literature and demonstrated that a circular trajectory can be learned in approximately 200 iterations compared to the 12000 reported in the literature. A figure eight trajectory was achieved in under 500 iterations compared to 20000 previously required. The trajectories computed using our new method are much closer to the target trajectories than was reported in previous studies. NASA

N93-17369# Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.
MOBILE MANIPULATOR CONFIGURATION OPTIMIZATION USING EVOLUTIONARY PROGRAMMING
J. R. McDonnell (Naval Command, Control and Ocean Surveillance Center, San Diego, CA.), B. L. Andersen (Naval Command, Control and Ocean

Surveillance Center, San Diego, CA.), W. C. Page (Naval Command, Control and Ocean Surveillance Center, San Diego, CA.), and F. G. Pin 1992 13 p Presented at the 1st Annual Conference on Evolutionary Programming, La Jolla, CA, 21-22 Feb. 1992
(Contract DE-AC05-84OR-21400)
(DE92-041307; CONF-9202137-1) Avail: CASI HC A03/MF A01

Multi-degree-of-freedom manipulators are becoming commonplace on mobile platforms. Full autonomy of mobile manipulator robotic systems will depend on the ability to resolve the inherent kinematic redundancy in task commutation. This work investigates the application of an evolutionary search strategy for determining near-optimal mobile manipulator configurations. Joint torques, obstacle avoidance and manipulability are incorporated in a multi-criteria optimization formulation. A variety of aspects of the evolutionary programming paradigm are addressed via empirical studies on a two degree-of-freedom (DOF) manipulator. These studies investigate full configuration vector versus partial configuration vector mutation as well as mutation strategies which incorporate cost and iteration number. The results of this study are then applied to a planar three DOF manipulator mounted on a single DOF mobile base. Experiments indicate that the configuration optimization problem is amenable to a variety of mutation strategies. DOE

N93-17797# RRC, Inc., Bryan, TX.
NEURAL NETWORK APPLICATIONS: A LITERATURE REVIEW Interim Report, Sep. 1989 - Sep. 1992
Sheree K. Engquist and Larry T. Looper Nov. 1992 40 p
(Contract F41689-88-D-0251)
(AD-A258148; AL-TP-1992-0044; AL-AL/Brooks) Avail: CASI HC A03/MF A01

Neural networks have been applied to a very broad range of tasks in many different disciplines. The focus of the discussion is on those areas closely related to potential applications in the Air Force personnel system. Similarities between the neural network applications and existing or potential personnel problems were described. Results of other researchers were examined in areas with problems similar to the personnel system and their specific architectures discussed. GRA

N93-16772*# Drexel Univ., Philadelphia, PA. Dept. of Electrical and Computer Engineering.
FUNCTIONAL EXPANSION REPRESENTATIONS OF ARTIFICIAL NEURAL NETWORKS
W. Steven Gray *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 121-123 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17336*# Alabama Univ., Tuscaloosa. Dept. of Aerospace Engineering.
NEURAL NETWORK ARCHITECTURES TO ANALYZE OPAD DATA
Kevin W. Whitaker *In its* 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N93-15717*# Alabama Univ., Huntsville. Dept. of Mathematical Sciences.
ACCURATE COMPUTATION AND CONTINUATION OF HOMOCLINIC AND HETEROCLINIC ORBITS FOR SINGULAR PERTURBATION PROBLEMS Final Technical Report, 22 Feb. 1990 - 21 Oct. 1992
Mark J. Friedman and Anand C. Monteiro 21 Oct. 1992 71 p
(Contract NAS8-36955)
(NASA-CR-191419; NAS 1.26:191419; UAH-5-32341) Avail: CASI HC A04/MF A01

In earlier paper Doedel and the author have developed a numerical method and derived error estimates for the computation of branches of heteroclinic orbits for a system of autonomous ordinary differential equations in R(exp n). The idea of the method is to reduce a boundary value problem on the real line to a boundary value problem on a finite interval by using a local (linear or higher order) approximation of the stable and unstable manifolds. A practical limitation for the computation of homoclinic and heteroclinic orbits has been the difficulty in obtaining starting orbits. Typically these were obtained from a closed form solution or via a homotopy from a known solution. Here we consider extensions of our algorithm which allow us to obtain starting orbits on the continuation branch in a more systematic way as well as make the continuation algorithm more flexible. In applications we use the continuation software package AUTO in combination with some initial value software. The examples considered, include computation of homoclinic orbits in a singular perturbation problem and in a turbulent fluid boundary layers in the wall region problem. Author

N93-15848# California Univ., Berkeley. Dept. of Mathematics.
MINIMUM EIGENVALUE SEPARATION
Beresford Parlett and Tzon-Tzer Lu Jul. 1992 68 p
(Contract N00014-90-J-1372)
(AD-A256570; PAM-560) Avail: CASI HC A04/MF A01

For over one hundred years, the eigenvalue problem has been investigated by mathematicians, physicists, and engineers. Scientists explored the characterization, location, perturbation, and computation of eigenvalues, to name a few topics. This thesis is devoted to the separation of eigenvalues. We will find the minimum gap between eigenvalues over an interesting class of tridiagonal matrices. We consider unreduced n x n symmetric tridiagonal matrices with all subdiagonal entries. GRA

N93-15879# Lawrence Livermore National Lab., CA.
PRECONDITIONED TIME-DIFFERENCE METHODS FOR SOLVING ADVECTIVE-DIFFUSIVE SYSTEMS
G. Rodrigue and D. Wolitzer Apr. 1992 15 p Presented at the International Association Mathematics and Computers Simulation International Symposium on Mathematical Modelling and Computer Simulation, Bangalore (India), 7-11 Dec. 1992
(Contract W-7405-eng-48)
(DE92-014790; UCRL-JC-110450; CONF-921209-2) Avail: CASI HC A03/MF A01

Explicit time differencing methods for solving differential equations are advantageous in that they are easy to implement on a computer and are intrinsically very parallel. The disadvantage of explicit methods is the severe restrictions that are placed on stable time-step intervals. Stability bounds for explicit time differencing methods on advective-diffusive problems are generally determined by the diffusive part of the problem. These bounds are very small and implicit methods are used instead. The linear systems arising from these implicit methods are generally solved by iterative methods. Herein, a methodology is developed for increasing the stability bounds of standard explicit finite differencing methods by combining explicit methods, implicit methods, and iterative methods in a novel way to generate new time-difference schemes, called preconditioned time-difference methods. A stability analysis is performed on a particular version of this method for the diffusion equation. Several computational examples of advective-diffusive problems are solved to demonstrate the increased stability limits. DOE

N93-15897# California Univ., Berkeley. Lawrence Berkeley Lab.
DEVELOPMENT AND APPLICATION OF THE QUASI-POTENTIAL TRANSFORMATION Ph.D. Thesis
B. Pillay Aug. 1992 82 p
(Contract DE-AC03-76SF-00098)
(DE93-000580; LBL-32728) Avail: CASI HC A05/MF A01

The quasi-potential transformation, based on the Kirchhoff transformation, reduces the equations governing mass-transfer in a steady-state, nonconvective electrolytic system into two independent parts. The geometry-specific part involves the solution of Laplace's equation subject to the relevant boundary conditions. The system-specific part involves the solution of a set of coupled first-order, nonlinear, ordinary differential equations. We develop a theoretical basis for the quasi-potential transformation using potential theory. The major assumption on which the quasi-potential transformation is based is that the concentrations can be written as single-valued functions of the electrostatic potential. We see how the system-specific part of the calculation is developed. Boundary conditions are outlined, and the geometry-specific calculations for the disk

and hemisphere electrodes are developed. We combine the system-specific calculations for the binary and acidic copper sulfate solutions with these geometry-specific calculations to obtain complete concentration profiles, potential distributions, and current density distributions for these systems. We also investigate the effect of migration on limiting currents. DOE

N93-15921# Lawrence Livermore National Lab., CA.
RADIAL BASIS FUNCTIONS: A CLASS OF GRID-FREE, SCATTERED DATA APPROXIMATIONS
E. J. Kansa and R. E. Carlson 20 Mar. 1992 17 p Presented at the International Association Mathematics and Computers Simulation International Symposium on Mathematical Modelling and Computer Simulation, Bangalore (India), 7-11 Dec. 1992
(Contract W-7405-eng-48)
(DE92-012675; UCRL-JC-110061; CONF-921209-1) Avail: CASI HC A03/MF A01

Recent developments in the theory and applications of radial basis functions are summarized. One intriguing property of such approximation methods is that rates of convergence improve with increasing dimensions. Also, such approximations, under favorable circumstances, can have exponential convergence. Numerical applications, especially on sparse scattered data sets of high dimensions, validate these theoretical claims. DOE

N93-15944# Argonne National Lab., IL. Mathematics and Computer Science Div.
AUTOMATIC DIFFERENTIATION BIBLIOGRAPHY
G. F. Corliss, comp. Jul. 1992 30 p
(Contract W-31-109-eng-38)
(DE92-040599; ANL/MCS-TM-167) Avail: CASI HC A03/MF A01

This is a bibliography of work related to automatic differentiation. Automatic differentiation is a technique for the fast, accurate propagation of derivative values using the chain rule. It is neither symbolic nor numeric. Automatic differentiation is a fundamental tool for scientific computation, with applications in optimization, nonlinear equations, nonlinear least squares approximation, stiff ordinary differential equation, partial differential equations, continuation methods, and sensitivity analysis. DOE

N93-15961# Carnegie-Mellon Univ., Pittsburgh, PA. Graduate School of Industrial Administration.
PROJECTION WITH A MINIMAL SYSTEM OF INEQUALITIES Technical Report, Jul. 1992
Egon Balas Jul. 1992 9 p
(Contract N00014-85-K-0198; NSF DDM-89-01495)
(AD-A257237; CMU/MSRR-585) Avail: CASI HC A02/MF A01

Projection of a polyhedron involves the use of a cone whose extreme rays induce the inequalities defining the projection. These inequalities need not be facet defining. We introduce a transformation that produces a cone whose extreme rays induce facets of the projection. GRA

N93-15969# Mitre Corp., Bedford, MA.
A PIPELINED, HIGH-PRECISION FFT ARCHITECTURE
Thomas M. Hopkinson and G. M. Butler Oct. 1992 23 p
(Contract F19628-89-C-0001)
(AD-A257235; MTP92B0000004) Avail: CASI HC A03/MF A01

This paper presents a highly-integrated, high-precision FFT architecture. A 1.2 um CMOS implementation of this architecture has yielded a 32-bit, 64K-point FFT that operates at a continuous 4-million-samples-per-second data rate. All FFT support functions, including coefficient generation and memory interfacing, are included on-chip. GRA

N93-16068# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Computer Science.
FIXED POINTS IN SPECTRAL COMPLEXITY
Sean W. Smith and Carl Sturtivant Oct. 1992 16 p
(Contract F33615-90-C-1465; ARPA Order 7597)
(AD-A256729; CMU-CS-92-190) Avail: CASI HC A03/MF A01

Spectral analysis has emerged as an exciting tool in complexity research. In some cases, the functions in a complexity class can be characterized by specifying a simple property of their Fourier spectra--even though their truth tables do not display such simple properties. In this paper, we demonstrate a fundamental limitation of this tool: if a class of functions contains parity and is closed under some simple composition rules, then we can take the set of Fourier spectra of a subset of that class, close it under some simple projections, and obtain everything in the original class. Indeed, we can demonstrate this property for a general family of transforms, of which the parity-based Fourier transform is only one. If a class contains the basis function of such a transform, then no reduction in complexity is obtained when we shift from truth tables to spectra. GRA

N93-16129# Florida State Univ., Tallahassee. Dept. of Statistics.
MULTIDIMENSIONAL STRONG LARGE DEVIATION THEOREMS
Narasinga R. Chaganty and Jayaram Sethuraman Sep. 1992 28 p
(Contract DAAL03-90-G-0103)
(AD-A256939; ARO-27868.22-MA) Avail: CASI HC A03/MF A01

We obtain a strong large deviation result for arbitrary sequence of random vectors under simple and verifiable conditions on the moment generating functions. The key to this result is a local limit theorem for arbitrary sequences of random vectors which is also provided. The local limit theorem gives conditions on the characteristic functions of random vectors for their pseudo-density function to converge uniformly on bounded sets. We apply these results to the multivariate F-distribution. GRA

N93-16201# Argonne National Lab., IL.
DOMAIN DECOMPOSITION AS A MECHANISM FOR USING ASYMPTOTIC METHODS
W. D. Gropp and D. E. Keyes (Yale Univ., New Haven, CT.) 1992 11 p Presented at the NATO Workshop on Numerical Methods for Partial Differential Equations and Critical Parameters, Beaune, France, 25-28 May 1992
(Contract W-31-109-eng-38)
(DE92-040759; ANL/CP-77114; CONF-9205253-1) Avail: CASI HC A03/MF A01

This paper summarizes some recent advances in numerical analysis for PDE's, particularly those in algebraic domain decomposition techniques, and demonstrates how such methods may be combined with asymptotic methods to provide robust and effective solvers. DOE

N93-16247# Superconducting Super Collider Lab., Dallas, TX.
AN APPROXIMATE INVARIANT USING LIE ALGEBRA
T. Garavaglia Aug. 1992 6 p Presented at the 26th International Conference on High Energy Physics, Dallas, TX, 6-12 Aug. 1992
(Contract DE-AC35-89ER-40486)
(DE93-000564; SSCL-Preprint-137; CONF-920837-7) Avail: CASI HC A02/MF A01

An approximate invariant is found for sextupole transverse dynamics. It is represented in terms of the elements of a Lie algebra associated with a sextupole contribution to the time-dependent Hamiltonian for transverse dynamics. DOE

N93-16266# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
REPRESENTATION OF RESEARCH PARADIGMS AS A FUNCTION OF FAMILIARITY WITH RESEARCH DOMAINS Final Report
J. M. Schraagen 7 Jul. 1992 31 p
(AD-A256553; IZF-1992-B-4; TDCK-92-0259) Avail: CASI HC A03/MF A01

The purpose was to determine how the content or quality of the representation of knowledge of experimental design improves as a function of problem familiarity. Problem familiarity was systematically varied for each subject separately. Five research domains were chosen for each subject and from each domain a journal article was chosen. One sentence describing the question to be answered in the article was extracted from each of the five articles and presented to the subject. Choice of the correct paradigm was assessed by asking the subjects to classify a particular research question as being of a certain type. The content of the paradigm was assessed by asking subjects to write down as many characteristics for this type of research as they could. Thirty-four subjects participated in the experiment. The results showed that only when subjects were highly familiar with a research area did they list highly specific features. When confronted with problems only slightly outside their area of expertise, experts must rely upon general design knowledge and general knowledge about what are relevant features for the novel area. It was also shown that these types of knowledge are acquired rather soon after one has specialized in

a particular ares, given that no differences were found between subjects with three years of experience and subjects with thirty years of experience. GRA

N93-16293# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

NUMERICAL SOLUTION OF DYNAMICAL SYSTEMS WITH STATE-SPACE CONSTRAINTS

A. A. tenDam 7 Feb. 1990 72 p

(NLR-TP-89419-U; ETN-93-92858) Avail: CASI HC A04/MF A01

Numerical simulation of constrained dynamical systems is known to exhibit stability problems. It is shown that the transformation of a continuous set of equations to a discrete set of equations is the source of the stability problem. It is demonstrated that there is no need to introduce the index terminology to characterize difficulties with respect to numerical integration of differential algebraic equations. The use of the appropriate formulation automatically results in stable numerical integration of dynamical systems by a set of differential and algebraic equations. New theories that allow for stable numerical integration of constrained dynamical systems are presented. The derived numerical methods are robust with respect to errors in the initial conditions and to errors made during the integration process. As a consequence, perturbations in the initial conditions are allowed. The new theory is intended to constrain mechanical systems. Simulation results are included. ESA

N93-16337# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.

AN INTRODUCTION MECHANISM FOR RECURSIVE FUNCTIONS: A CASE STUDY

Mark vanderVoort Apr. 1992 42 p

(Memo-INF-92-34; ETN-92-92446) Copyright Avail: CASI HC A03/MF A01

The definitional mechanisms of HOL (Higher Order Logic) are put to the test. These are found to be overly restrictive. An extension to these mechanisms which allows a wider class of definitions of recursive functions is proposed. The properties of this extension are examined in two test cases. They show that although much work is required of the user, a substantial amount of automated theorem proving can still be done. ESA

N93-16342# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).

ON GUPTA-BLEULER QUANTIZATION OF SYSTEMS WITH SECOND-CLASS CONSTANTS

Wolfgang Kalau 10 Feb. 1992 17 p

(NIKHEF-H/92-05; ETN-93-92815) Avail: CASI HC A03/MF A01

Hamiltonian systems with mixed first and second class constraints are discussed. A proof that in a neighborhood of the constraint surface the complexified constraints can always be split into a holomorphic and an antiholomorphic set, such that the holomorphic set can be implemented consistently on the ket-states of the corresponding quantum theory, is given. The quantization is performed with BRST methods using a nonhermitian BRST operator. As an example, this method is used to quantize the four dimensional superparticle. ESA

N93-16349# Rome Univ. (Italy). Dipartimento di Fisica.

QUANTUM GROUPS AND LIE-ADMISSABLE TIME EVOLUTION

A. Jannussis (Patras Univ., Greece), G. Brodimas (Patras Univ., Greece), and R. Mignani (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 12 Mar. 1991 8 p

(SSCL-Preprint-793; ETN-93-92902) Avail: CASI HC A02/MF A01

The time evolution of the operators for q oscillators is derived for two prameters. The connection between q deformation and Lie admissible algebras is exploited. An analogous problem is not yet solved for any quantum group, even for the case of the q deformed oscillator. The Santilli's generalization of Heisenberg's equation of motion, which rules the time evolution of operators, is discussed. The exponential form of the time evolution for the operator A, obtained from the generalized Heisenberg equation for the Lie admissible Q-algebra, is given. ESA

N93-16350# Groningen Rijksuniv. (Netherlands). Dept. of Computing Science.

A FAILURES MODEL FOR DELAY-INSENSITIVE PROCESSES AND THE SOUNDNESS OF LAWS FOR GUARDED CHOICE

Paul G. Lucassen and Jan Tijmen Udding 1991 31 p

(CS-9106; ETN-93-92831) Avail: CASI HC A03/MF A01

A delay insensitive process models the asynchronous interaction by input and output between a system and its environment when no assumptions about delays of signals are made. A model underpinning an algebra for delay insensitive processes is presented. Laws in the algebra are given and proved correct with respect to the model. A delay insensitive process is receptive in the sense that inputs are never blocked. If a system is not ready to receive a particular input, its subsequent behavior is chaotic. The algebric laws used in the design circuits are proved to be complete. The algebric operators and their meanings in the model are presented. It is shown that the application of an operator to a di-process yields a di-process again and that the operators are continuous. The resulting model is simpler than the failures divergences model, because refusal sets can be eliminated. ESA

N93-16352# Groningen Rijksuniv. (Netherlands). Dept. of Computing Science.

COMPLETENESS OF A DELAY-INSENSITIVE ALGEBRA

Rix Groenboom, Mark B. Josephs (Oxford Univ., England), Paul G. Lucassen, and Jan Tijmen Udding 1992 32 p

(CS-9203; ETN-93-92833) Avail: CASI HC A03/MF A01

A process algebra is given for specifying delay insensitive processes. A delay insensitive process models the asynchronous communication between a system and its environment. In two steps it is demonstrated that expressions in this algebra have a normal form, as a consequence of which the algebra is complete. First, the number of operators in process expressions is reduced by a set of rewrite laws. The resulting expressions are in a so called prenormal form. Some additional laws to transform a process from its prenormal form to its normal form are introduced. The approach, to prove that the algebra is complete, gives clues as to which laws to introduce. The purpose of each law is to make a step towards an expression's normal form. The last step in the transformation to normal form turned out to be nontrivial. Especially tricky is the proof that the transformation procedure terminates. With the proofs of completeness and soundness of the algebra, the way is clear to use the algebra for actual delay insensitive circuit design. ESA

N93-16353# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.

MEASURABILITY OF OPERATOR FIELDS

E. G. F. Thomas 1992 19 p Supersedes W-9203

(W-9204; W-9203; ETN-93-92834) Avail: CASI HC A03/MF A01

Work to prepare the way for a smooth theory of random operators is presented. A random operator is nothing but a probability measure on a set of operators for definiteness operators in a separable Hilbert space. In most cases such a random operator will be induced by a measurable map from a parameter probability space omega to the space of operators. The study shows that important classes of linear operators in a separable Hilbert space, such as the closed operators, closed invertible operators, closed densely defined operators, self adjoint operators, and other sets of operators, bounded or unbounded, defined in terms of spectra are in a topology defined by the intermediary of the graphs, Lusin spaces. The main theorem shows that families T(sub omega), where omega belongs to Omega of self adjoint operators having a certain type of common core D, depend measurably on omega if the maps omega with limit in T sub omega are measurable for all phi and psi of D. This is applied to show that self adjoint differential operators whose coefficients are measurable functions of the parameter omega, depend on omega as operators. ESA

N93-16354# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.

CONVERGENCE OF JULIA SETS IN THE APPROXIMATION OF LAMBDA e(SUP z) BY LAMBDA (1 + z/d)(SUP d)

Bernd Krauskopf 1992 24 p

(W-9205; ETN-93-92835) Avail: CASI HC A03/MF A01

The polynomials P(sub d, lambda)(Z): = lambda (1 +Z/d)(exp d) converge uniformly on compact sets to E(sub lambda)(Z): = (lambda)e(exp Z). The purpose of the study is to show the convergence of the corresponding Julia sets in the Hausdorff metric for two cases. First for

lambda such E(sub lambda) has an attracting periodic orbit, in which case its Julia set is a Cantor set of curves, and secondly for lambda such that the Julia set of E(sub lambda) is the whole plane C. The results from iteration theory, needed in the sequel, are reviewed. The Hausdorff convergence orbits are considered. The key ideas of the algorithms designed to illustrate this convergence are given. ESA

N93-16366# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
HEREDITARILY-FINITE SETS AND COMPLETE METRIC SPACES
J. J. M. M. Rutten Oct. 1991 20 p Sponsored in part by Commission of the European Communities and Netherland Organization for Applied Scientific Research
(CWI-CS-R9148; ETN-92-92489) Copyright Avail: CASI HC A03/MF A01

The collection of hereditarily finite sets is considered under the assumption of a nonstandard axiom system. In this system the axiom of foundation is replaced by a strong version of its negation, the antifoundation axiom. An isomorphism is established between this collection of hereditarily finite sets and a complete metric space obtained as solution of a recursive domain equation. The theory of solving reflexive domain equations in a category of complete metric spaces is taken as a starting point. It gives the existence of a unique solution for a large collection of domain equations. The resulting domain contains unlabeled trees, called 'processes', and comes with a natural distance function: the distance between two trees is small if their finite approximations are equal at great depth. An edge in such a process is related to an edge in the graph representations of hereditarily finite sets: it denotes the membership relation. Next a mapping is defined that associates with every hereditarily finite set a process, representing its canonical picture. ESA

N93-16367# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
NORMAL FORMS IN REAL TIME PROCESS ALGEBRA
Willem Jan Fokkink Oct. 1991 25 p Sponsored in part by Commission of the European Communities and Netherlands Organization for Applied Scientific Research
(CWI-CS-R9149; ETN-92-92490) Copyright Avail: CASI HC A03/MF A01

The extension of basic process algebra with real time is considered. The theory of this extension contains an axiom that can only be verified by an uncountable number of checkings. So at first sight equality between process terms is undecidable. An explicit construction for reducing time closed process terms is given. Via intermediate terms, the so called conditional terms, a time closed process term is rewriten to a normal form, which is again a time closed process term. This normal form is proven to be unique modulo commutativity and associativity of the +. Furthermore, if the equality p = q holds in the axiom system, then p and q have the same normal form. For each pair of process terms p, it is decidable whether the equality p = q holds or not. ESA

N93-16368# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
IMPLEMENTING HIGHER-ORDER ALGEBRAIC SPECIFICATIONS
J. Heering Dec. 1991 15 p Sponsored in part by Commission of the European Communities and Netherlands Organization for Applied Scientific Research
(CWI-CS-R9150; ETN-92-92491) Copyright Avail: CASI HC A03/MF A01

Operational experiments with higher order algebraic specifications are performed by translating them to lambda PROLOG, and extension of PROLOG to polymorphically typed lambda terms based on higher order unification. Writing algebraic specifications that are to be executed as rewrite systems is similar to functional programming. Algebraic specification languages allow left hand sides of equations to be complex first order patterns that would not be allowed in functional languages. Functional languages, on the other hand, have powerful higher order features not offered by algebraic specification languages. Some functional languages combine higher order functions with linear first order patterns involving free data type constructors, thus offering a limited mixture of functional programming and algebraic specification. A more ambitious integration of the two is obtained by allowing both signatures and equations in algebraic specifications to be higher order. ESA

N93-16416# Rome Univ. (Italy). Dipartimento di Fisica.
A SIMPLE METHOD TO GENERATE INTEGRABLE SYMPLECTIC MAPS
O. Ragnisco (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 20 Mar. 1991 5 p
(Preprint-795; ETN-93-92904) Avail: CASI HC A01/MF A01

It is shown that by taking stationary flow of integrable evolution equations on lattices, integrable symplectic maps are obtained. An alternative method based on the nonlinearization of a scattering problem is discussed. Its intimate connections with the previous one is explained. Examples of integrable maps are presented. The key points to prove that it is reasonable to expect that stationary flows of integrable discrete evolution equations are integrable discrete time systems, are given. ESA

N93-16417# Rome Univ. (Italy). Dipartimento di Fisica.
STOCHASTIC REACTION DIFFUSION EQUATIONS AND INTERACTING PARTICLE SYSTEMS
G. Jona-Lasinio 17 Apr. 1991 11 p Submitted for publication
(Preprint-796; ETN-93-92905) Avail: CASI HC A03/MF A01

Progress in the theory of stochastic reaction diffusion equations is summarized. These equations constitute nonlinear partial differential systems of parabolic type perturbed by white noise in time and space. Their role in describing deviations from hydrodynamic behavior in the statistical mechanics of simple models is discussed. The limits of such a description are qualitatively analyzed and exact calculations are provided. The equations that were rigorously obtained by an appropriate renormalization procedure are presented. The notion of parabilistic weak solution and its construction are discussed. The dependence of fluctuations, which are characteristic of these equations, are pointed out. Theoretical data concerning fluctuations for stochastic parabolic equations and results obtained from special microscopic models are compared. ESA

N93-16442# Rome Univ. (Italy). Dipartimento di Fisica.
ON A CLASS OF STOCHASTIC REACTION-DIFFUSION EQUATIONS IN TWO SPACE DIMENSIONS
G. Jona-Lasinio and R. Seneor (Ecole Polytechnique, Paris, France) 10 Jan. 1991 13 p
(Preprint-777; ETN-93-92891) Avail: CASI HC A03/MF A01

Work aimed at proving for any finite time, the existence of a weak dynamics for a class of reaction diffusion systems on two space dimensions perturbed by a white noise is presented. This class includes models which may exhibit complex behavior in space and time. The approach, based on the methods of constructive quantum field theory, extends previous results established for gradient type systems. These equations represent a particular case of infinite dimensional stochastically perturbed dynamical systems which appear naturally. The restriction to gradient type equations excludes those situations where the corresponding deterministic system may exhibit chaotic behavior. It is shown that the theory can be extended to a class of non gradient systems. ESA

N93-16551# Argonne National Lab., IL.
SYMMETRY OF WAVEFUNCTIONS IN QUANTUM ALGEBRAS AND SUPERSYMMETRY
C. K. Zachos 1992 4 p Presented at the 21th Differential Geometric Methods in Theoretical Physics Conference, Tianin, China, 5 Jun. 1992
(Contract W-31-109-eng-38)
(DE92-041129; ANL-HEP-CP-92-53; CONF-9206289-1) Avail: CASI HC A01/MF A01

The statistics-altering operators Eta present in the limit q = -1 of multiparticle SU(sub q)(2) invariant subspaces parallel the action of such operators which naturally occur in supersymmetric theories. I illustrate this heuristically by comparison to a toy N = 2 superymmetry algebra, and ask whether there is a supersymmetry structure underlying SU(sub q)(2) in that limit. I remark on the relevance of such alternating-symmetry multiplets to the construction of invariant hamiltonians. DOE

N93-16566# Technische Univ., Delft (Netherlands).
ON THE SUM OF ACCRETIVE OPERATORS Ph.D. Thesis
Paulus Joannes Pius Egberts 1992 109 p Sponsored by Netherlands

Organization for Applied Scientific Research
(ETN-92-92794) Avail: CASI HC A06/MF A02

The sum of a linear and nonlinear m-accretive operator in a Hilbert space is studied. The following question, is considered: when is the sum m-accretive as well. This question has no immediate answer unless additional assumptions are imposed on the operators involved. The definition of a nonlinear, possibly multivalued, m-accretive operator in a Banach space is given. Some known results provide a way to show the m-accretivity of the sum of two m-accretive operators in a Hilbert space. The case of two m-accretive and resolvent computing operators, L and A, which form an acute angle in a real Hilbert space, is analyzed. It is shown that angle boundedness is equivalent to the notion of regular accretivity. Applications concerning elliptic systems and Volterra equations are included. ESA

N93-16587# Argonne National Lab., IL.
DOMAIN DECOMPOSITION: A BLOWUP PROBLEM AND THE GINZBURG-LANDU EQUATIONS
Man Kam Kwong 1992 16 p Presented at the NATO Workshop on Numerical Methods for Partial Differential Equations and Critical Parameters, Beaune, France, 25-28 Sep. 1992
(Contract W-31-109-eng-38)
(DE92-040736; ANL/CP-77115; CONF-9209217-1) Avail: CASI HC A03/MF A01

In two of our recent projects, the technique of domain decomposition plays a crucial role in the numerical integration of the partial differential equations. In our problems, the local behavior varies because of the nonlinear and singular nature of the equations. Attempts to introduce different length scales did not lead to improvement. We found that different form of the equations have to be used over different subdomains. The first project arises in an effort to determine the profile at the moment of blowup or quenching of a nonlinear heat equation. The second project arises in the investigation of the Ginzburg-Landau equation in the theory of superconductivity. DOE

N93-16593# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
GEOMETRIC ERGODICITY, QUASI-STATIONARY AND RATIO LIMITS FOR RANDOM WALKS
Erik A. vanDoorn and Pauline Schrijner Feb. 1992 50 p
(MEMO-1033; ETN-92-92461) Avail: CASI HC A03/MF A01

Three aspects of random walks (skipfree Markov Chains in the nonnegative integers) in each of which the decay parameter turns out to play a central role are studied. Conditions for geometric ergodicity and bounds for the decay parameter are obtained and conditions for the existence of the limits as n towards infinity of ratios of n-step transition probabilities are developed. Finally, the existence and shape of quasi-stationary and quasi limiting distributions are discussed. The analyses rely heavily on the spectral representation for the n-step transition probabilities of a random walk developed by Karlin and McGregor. ESA

N93-16594# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
COMPARISON OF TESTS, AND LOCAL FAMILIES
Wilbert C. M. Kallenberg and Feike C. Drost (Tilburg Univ., Netherlands) Feb. 1992 26 p
(MEMO-1034; ETN-92-92462) Avail: CASI HC A03/MF A01

Several aspects of comparison of tests using efficiency concepts are addressed. In exponential families, Bahadur optimality over most of the parameter space is shown to be essentially restricted to the likelihood ratio tests. The limiting efficiency is investigated as an approximation tool for the finite sample relative efficiency. The likelihood ratio test, Rao's test, and Wald's test are compared in a typical testing problem, both locally and nonlocally. The theoretical results are compared with numerical results. Local efficiency and local limits of nonlocal efficiency are often applied in practice. For accurate approximation, the choice of an appropriate local family is important. Using global approximation, such families are derived from the Cressie-Read statistics for testing goodness of fit. Although often dismissed, approximate Bahadur efficiency turns out to work well as approximation to the finite sample relative efficiency. ESA

N93-16606# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
ANALYSING THE TRANSFER FUNCTIONS OF NONLINEAR SYSTEMS IN THE FREQUENCY DOMAIN
H. Zhang and Steve A. Billings 29 Jan. 1992 36 p
(Contract SERC-GR/F-8564-2)
(RR-445; ETN-92-92770) Avail: CASI HC A03/MF A01

Both continuous and discrete time transfer functions of nonlinear systems are analyzed and interpreted in the frequency domain by investigating the properties and graphical representation of these functions. The contributions that some typical terms from nonlinear time domain models make to the transfer functions are illustrated. From the studies of nonlinear transfer functions it is found that many results and properties are similar to and can be considered as simple extensions of the linear case. Both the linear and nonlinear transfer functions have two fundamental advantages to most prospective applications: they convert complex differential/integral operations into simple multipication/division operations, and they provide a convenient way of dealing with the frequency response analysis and interpretation of systems. Many nonlinear phenomena may be revealed and predicted using the nonlinear transfer functions. The transfer function approach of nonlinear systems analysis is a useful tool in many branches of sciences and engineering. ESA

N93-16640# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
NOTE ON THE AVERAGE RANK OF LYM-SETS
Peter L. Erdoes, Ulrich Faigle, and Walter Kern Feb. 1992 20 p
(MEMO-1036; ETN-92-92464) Avail: CASI HC A03/MF A01

The average rank of LYM (Lubell, Yamamoto, Mashalkin) sets is studied. An m-analog of the Kleintman and Miller theorem (which determined the best possible bound on the average rank of an antichain in a Boolean algebra if the antichain has at least size (n,k)) by looking at the average rank of sets with cardinality at least the sum of $m + 1$ successive level numbers is derived. A general model is used as a start, and the profile vector of subsets are studied and normalized relative to a rank function. For results on the average rank, the linear program Odlyzko solved to deduce the Kleintman and Miller theorem is generalized. The feasibility region of an associated dual program is studied and an optimal solution for the geometric analysis is found. ESA

N93-16643# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
ON EFFICIENTLY CHARACTERIZING SOLUTIONS OF LINEAR DIOPHANTINE EQUATIONS AND ITS APPLICATION TO DATA DEPENDENCE ANALYSIS
C. Eisenbeis (Institut National de Recherche d'Informatique et d'Automatique, Rennes, France), O. Temam (Institut National de Recherche d'Informatique et d'Automatique, Rennes, France), and H. Wijshoff Jan. 1992 27 p
(RUU-CS-92-01; ETN-93-92801) Avail: CASI HC A03/MF A01

Several sets of mathematical tools for characterizing the solutions of linear Diophantine equations are presented. A number of methods for reducing the complexity of the computations are given. Different techniques for determining the exact number of solutions of linear Diophantine equations are introduced. A method for efficiently extracting the solutions of such equations is presented. For all these methods, the main focus is put on their applicability and efficiency for data dependence analysis. ESA

N93-16669# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON HAMILTONIAN PROPERTIES OF 2-TOUGH GRAPHS
D. Bauer (Stevens Inst. of Tech., Hoboken, NJ.), H. J. Broersma, J. vandenHeuvel, and H. J. Veldman Feb. 1992 8 p
(Contract MDA904-89-H-2000)
(MEMO-1037; ETN-92-92465) Avail: CASI HC A02/MF A01

A study on Hamiltonian properties of 2-tough graphs is presented. A graph G is Hamiltonian if it contains a Hamilton cycle (a cycle containing every vertex of G); G is Hamiltonian connected if for every pair of distinct vertices x and y of G there is a Hamilton path (a path containing every vertex of G) with end vertices x and y. A well known conjecture in Hamiltonian graph theory states that every 2-tough graph is Hamiltonian. Some equivalent conjectures, for example the conjecture that every 2-tough graph is Hamiltonian connected, are given. ESA

N93-16677*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.

EFFICIENT DISTANCE CALCULATION USING THE SPHERICALLY-EXTENDED POLYTOPE (S-TOPE) MODEL

Gregory J. Hamlin, Robert B. Kelley, and Josep Tornero (Valencia Univ., Spain) Sep. 1991 11 p

(Grant NAGw-1333)

(NASA-CR-191858; NAS 1.26:191858; CIRSSE-104) Avail: CASI HC A03/MF A01

An object representation scheme which allows for Euclidean distance calculation is presented. The object model extends the polytope model by representing objects as the convex hull of a finite set of spheres. An algorithm for calculating distances between objects is developed which is linear in the total number of spheres specifying the two objects. Author

N93-16721# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.

STRONG SEQUENTIALITY OF LEFT-LINEAR OVERLAPPING REWRITING SYSTEMS

Yoshihito Toyama (Nippon Telegraph and Telephone Public Corp., Kyoto, Japan) Oct. 1991 26 p Sponsored in part by Netherlands Organization for Applied Scientific Research, Vrije Univ., and Katholieke Univ.

(CWI-CS-R9146; ETN-92-92487) Copyright Avail: CASI HC A03/MF A01

Huet and Levy showed that for every strongly sequential orthogonal term rewriting system, the index reduction strategy is normalizing. The purpose of this work is to extend their result to overlapping term rewriting systems. It is demonstrated that the index reduction is normalizing for the class of strongly sequential left linear term rewriting systems in which every critical pair can be joined with root balanced reductions. Normalizing reduction strategies play an important role in the implementation of functional programming languages based on reduction systems. The key idea behind the approach presented is the balanced weak Church-Rosser property. This concept gives a useful abstract framework for analyzing reduction strategies. ESA

N93-16726# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.

POLLING SYSTEMS AND MULTIPLE BRANCHING PROCESSES

J. A. C. Resing Dec. 1991 18 p

(CWI-BS-R9128; ETN-92-92479) Copyright Avail: CASI HC A03/MF A01

The joint queue length process in polling systems with and without switchover times is studied. If the service discipline in each queue satisfies a certain property it is shown that the joint queue length process at polling instants of a fixed queue is a Multitype Branching Process (MTBP) with immigration. In the case of polling models with switchover times, it turns out that an MTBP with immigration in each state is being dealt with. In the case of polling models without switchover times, it turns out that an MTBP with immigration in state zero is being dealt with. The theory of MTBP leads to expressions for the generating function of the joint queue length process at polling instants. Conditions for ergodicity and moment calculations are given. The analysis leads to known results for exhaustive and gated service disciplines and to new results for other service disciplines. The analysis can be extended to the following cases: models with Poisson batch arrivals; models with customer branching and customer routing; polling systems with fixed polling tables instead of cyclic polling systems; models with globally gated service; and discrete time polling systems. ESA

N93-16727# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.

OPEN PROBLEMS IN REWRITING

Nachum Dershowitz (Illinois Univ., Urbana.), Jean-Pierre Jouannaud (Paris-Sud Univ., Orsay, France), and Jan Willem Klop (Vrije Univ., Amsterdam, Netherlands) Dec. 1991 26 p Sponsored in part by EEC

(Grant NSF CCR-90-07195)

(CWI-CS-R9114; ETN-92-92480) Copyright Avail: CASI HC A03/MF A01

A collection of abstracts in rewriting and other equational paradigms is presented. The purpose of the test is to encourage and stimulate continued progress in this area. The attention is focalized on theoretical questions, though additional questions relating to applications and implementations are included. Several selected papers involving normalization, confluence, termination, validity, theorems and satisfiability on rewriting are presented. Some of the themes are: the definability of rewrite systems in rewrite systems; the notion of spectrum to abstract inessential details from graphs, the ground reducible concept with respect to a rewrite system R when all its ground instances contain a redex. The following questions are discussed: given a term in ordinary untyped lambda calculus, it is decidable whether it can be typed in the second order lambda 2 calculus; do the subjective pairing axioms D(sub 1)(Dxy) = x, D(sub 2)(Dxy) = y, and D(D(sub 1)x)(D(sub 2)x) = x conservatively. ESA

N93-16731# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.

A SHORT PROOF OF THE DECIDABILITY OF BISIMULATION FOR NORMAL BPA PROCESSED

Jan Friso Groote Dec. 1991 10 p Sponsored by EEC

(CWI-CS-R9151; ETN-92-92492) Copyright Avail: CASI HC A02/MF A01

A short and straightforward technique to prove the decidability of bisimulation for normed Basic Process Algrebra (BPA) is presented. The syntax of basic process expressions and the recursive specifications that guarantee recursive processes are given. The study is restricted to normed basic process algebra, and the norm of a process, p, is defined. The purpose of the work was to determine the complexity of deciding bisimulation for normed BPA processes. The results lead to a nondeterministic exponential algorithm. This proof technique is compared to another one, and the relationship between their main concepts are given. An open problem remains which is whether another more efficient algorithm exists. ESA

N93-16742# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.

A SOUND AND COMPLETE CALCULUS FOR UPDATE LOGIC

D. Jan N. vanEijck (OTS, Utrecht, Netherlands) and Fer-Jan deVries Dec. 1991 23 p

(CWI-CS-R9155; ETN-92-92496) Copyright Avail: CASI HC A03/MF A01

A sound and complete deduction system for Veltman's update logic in the style of the Hoare calculus with two kinds of correctness statements for dynamic assignment logic in Van Eijck and De Vries is presented. The Hoare correctness statements use modal propositional logic assertion language and connect update logic to the modal propositional logic S5. The connection with modal propositional logic provides a clear link between the dynamic and the static semantics of update logic. Update logic is already noted to be decidable; S5 provides an alternative proof. The S5 connection can also be used for rephrasing the validity notions of update logic and for performing consistency checks. ESA

N93-16743 Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.

POWERFUL ALGORITHM FOR INVERSION OF GEOPHYSICAL REFLECTION PROFILES M.S. Thesis

Refael Katzman Jul. 1990 122 p In HEBREW

(ITN-93-85179) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

Ray equations are derived by using the eikonal equation for the phase function, which is derived from the elasto-dynamic wave equation, and the dynamic ray tracing system is used to derive equations for the wavefront curvature. An algorithm is developed to trace a ray between two end points in an inhomogeneous layered medium. The velocities and the vertical velocity gradients are given at several node points and spline interpolation is performed through these points. The ray equations are calculated via a fourth-order Runge-Kutte method and the integration step is determined by the radius of curvature of the ray. The lower order methods are compared. Fast methods are presented for calculating the multi-offset time field. The methods are based on sending a couple of rays from the reflectors towards the upper interface; interpolation based on the arrival times of these rays gives the arrival times anywhere else. A version of the method in which only the central rays are sent up from the reflectors was tested, using two approximations (the binomial asymmetrical distribution and the oblique

spherical correction) to calculate the arrival times at the non-zero offsets. This method was found to be not suitable for far offsets and to be inaccurate for many structures. An algorithm is described which is used to solve the direct problem; it sends series of ray fans from each layer and performs interpolations only for the points for which knowledge of the arrival time is necessary. This algorithm was found to be very accurate. ISA

N93-16832# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.

A METRIC FOR LINE SEGMENTS

P. F. M. Nacken Dec. 1991 17 p Sponsored by Netherlands Organization for Scientific Research

(CWI-BS-R9126; ETN-92-92477) Copyright Avail: CASI HC A03/MF A01

The construction of a metric for comparing symbolic features or tokens in images is presented. These are representations of geometrical structures in the image. The metric is used to measure how strongly two features are related or how much they are alike. The case of line segments generated by an edge detection algorithm is described. In the case of line segments, such a metric measures co-linearity and separation. Different metrics can be defined by choosing different neighborhood functions. By choosing a proper neighborhood function, a metric satisfying the needs of a specific application can be constructed. A metric in the set of all line segments illustrates the approach. The usefulness of this metric is verified by using it in a clustering algorithm for detecting linear structures in images. ESA

N93-16833# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.

HAUSDORFF METRIC FOR CAPACITIES

A. J. Baddeley (Leiden Univ., Netherlands) Dec. 1991 31 p Submitted for publication

(CWI-BS-R9127; ETN-92-92478) Copyright Avail: CASI HC A03/MF A01

The Hausdorff metric is generalized to spaces of capacities and it is verified that the appropriate topologies are generated. Under natural identifications of spaces, it coincides with the Hausdorff metric for compact sets, the Levy-Prohorov metric for weak convergence of probability measures, and a quantity used in defining Skorohod's M sub 2 topology for D. The aim is to draw the above mentioned metrics together. A Hausdorff metric, which includes all the above mentioned metrics as special cases under the natural embeddings, is constructed. It is shown that the metrics generate the sup-weak topology for tight capacities, and that a related class of pseudometrics generates the vague topology for capacities. The approach relies on the distinction and duality between compact and closed sets, and correspondingly between weak and vague convergence of measures, and tight and nontight capacities. Definitions and facts about topologies on spaces of subsets, measures, semicontinuous functions and capacities are reviewed. The Hausdorff metric for closed and compact subsets, and the connection with Skorohod topology are studied. An application to stochastic process theory and the L(sup p) version of the Hausdorff metric are given. ESA

N93-16843# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

NONLINEAR H(INFINITY) CONTROL AND HAMILTON-JACOBI INEQUALITIES

Arjan J. vanderSchaft Mar. 1992 10 p

(MEMO-1042; ETN-92-92470) Avail: CASI HC A02/MF A01

The standard H(infinity) (sub)optical control problem is formulated and simple recent results concerning its solution are surveyed. Special emphasis is put on the use of the fundamental notion of dissipativity, in particular, the nonlinear bonded real lemma, and its geometric treatment based on the relation between Hamilton-Jacobi (in)equalities and invariant manifolds of Hamiltonian vectorfields. Necessary conditions for the solvability of the suboptimal H(infinity) problem are identified which reduce in the linear case to the well known necessary and sufficient conditions. For local solvability of the H(infinity) problem sufficient conditions are provided based on linearization arguments, and some problems with global solvability are indicated. ESA

N93-16844# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

CYCLES CONTAINING ALL VERTICES OF MAXIMUM DEGREE

H. J. Broersma, J. vandenHeuvel, H. A. Jung, and H. J. Veldman (Technische Univ., Berlin, Germany) Mar. 1992 15 p

(MEMO-1044; ETN-92-92471) Avail: CASI HC A03/MF A01

For a graph G and an integer k, denoted by V sub k the set (v is a member of the set of all V(G) with the property d(v) is greater than or = k), Veldman proved that if G is a 2-connected graph of order n with n less than or = 3k-2 and cardinal for the set V sub k less than or = k, then G has a cycle containing all vertices of V sub k. It is shown that the upper bound k on cardinal of the set V sub k is close to best possible in general. For the special case k = Delta(G), it is conjectured that the condition cardinal of the set V sub k less than or = k can be omitted. Using a variation of Woodall's Hopping lemma, the conjecture is proved under the additional condition that delta(G) is greater than or = n-1-2Delta(G). This result is an almost generalization of Jackson's theorem that every 2-connected k-regular graph of order n with n less than or = 3k is hamiltonian. An alternative proof of an extension of Jackson's theorem is also presented. ESA

N93-16845# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

CONSTRUCTION OF MONOTONE EXTENSIONS TO BOUNDARY FUNCTIONS

C. R. Traas Mar. 1992 12 p

(MEMO-1045; ETN-92-92472) Avail: CASI HC A03/MF A01

The construction of monotone extensions to boundary functions is studied: given monotonically increasing, smooth, univariate functions along the edges of the unit square, the problem is to construct an extension towards the interior of the square such, that the resulting F(x,y) is monotone and of class C(sup 1). A nonlinear method which defines F in terms of a set of level lines, each of which is represented as a cubic Bezier curve, is presented. Considering a sequence of these level lines, the corresponding control points shift along trajectories which contain kinks. ESA

N93-16850# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.

CALCULATE CATEGORICALLY

Maarten M. Fokkinga Jun. 1991 27 p

(CWI-CS-R9132; ETN-92-92481) Copyright Avail: CASI HC A03/MF A01

An algebraic calculation is proposed as an alternative proof technique in category theory. It is made possible thanks to a notation for various 'unique arrows' and a suitable formulation of 'initiality', and the properties brought forward by initiality. The calculations presented can be interpreted as a kind of functional programming. The combinations and transformations of morphisms (functions) are fully in the spirit of Backus and Meertens. In this paper it is just by composing functions in various ways that new functions are formed and equalities are proved. The absence of restrictions in combining functions has often been claimed to be a major benefit of functional programming. Notation and terminology are explained, some lesser known categorical concepts are defined, and initiality is discussed. The laws for initiality to products and coproducts, to initial algebras, to coequalizers and kernel pairs, and to colimits in general, are presented. ESA

N93-16851# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.

DATATYPE LAWS WITHOUT SIGNATURES

Maarten M. Fokkinga Jun. 1991 34 p

(CWI-CS-R9133; ETN-92-92482) Copyright Avail: CASI HC A03/MF A01

Using the categorical notion of 'functor' the notion of data type (algebra) may be defined without being forced to introduce a signature, that is, names for the individual sorts (types) and operations involved. This is advantageous for those theory developments where one is not interested in the syntactic appearance of an algebra. A categorical formalization of the notion of 'law' for data types, where no signature is needed, is presented. The categorical, signatureless formalization of 'algebra' is reviewed. The definition of 'transformer' and 'law', and some rationale for it are presented. The expressiveness of transformers and laws are included. The crucial

promotion property of transformers is shown to be related to naturality and Wadler's Theorems For Free theorem. The use of the promotion property of transform on the following cases: for one half of a Birkhoff characterization of the classes that can be specified with laws; to show that theorems from the literature are used to show the existence of initial lawful algebras; to demonstrate that any colimit is in fact a lawful algebra; to discuss equatorial specifications of data types. ESA

N93-16852# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
THE STATE OPERATOR IN REAL TIME PROCESS ALGEBRA
J. C. M. Baeten (Amsterdam Univ., Netherlands) and J. A. Bergstra (Amsterdam Univ., Netherlands) Sep. 1991 20 p Presented at REX Workshop on Real Time: Theory on Practice, 1991 Submitted for publication Sponsored in part by EEC
(CWI-CS-R9140; ETN-92-92483) Copyright Avail: CASI HC A03/MF A01

An extension of a real time process algebra with a state operator is provided. For this purpose it is plausible to use a version of real time process algebra with located actions. Departing from a finite set A of action names and a finite set L of location names, a version of the real space process algebra is developed. Timed deadlocks are used instead of the untimed deadlock. A modified version of operational semantics is presented. The extension of a real time process algebra is not a straightforward process, reflecting the fact that it is difficult to have a motion of global state in a distributed system. To solve the problem, an ordering on the locations and the evaluation of multi-orders in increasing order are required. The study leads to the conclusion that it is possible to add a state operator to real time process algebra. The state operator can be useful to describe communication between a sender and a moving receiver. ESA

N93-16952# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
CONTROLLABILITY DISTRIBUTIONS AND SYSTEMS APPROXIMATIONS: A GEOMETRIC APPROACH
A. C. Ruiz and H. Nijmeier Mar. 1992 20 p Sponsored by CONACYT, Mexico
(MEMO-1040; ETN-92-92468) Avail: CASI HC A03/MF A01

A study which, given a nonlinear system, determines at an equilibrium point a relation between controllability distributions defined for a nonlinear system and a Taylor series approximation of it, is presented. It is known from nonlinear control theory that the solvability conditions of some control synthesis problems can be stated in terms of geometric concepts like controlled invariant (controllability) distributions. By dealing with a k-th Taylor series approximation of the system, the decision of when a solution based on the appoximation serves at the same time as an approximation of a true solution for the original problem is made. Results along this line are obtained provided the control problem is solvable for the nonlinear system and its linearization. Some examples illustrate the results. ESA

N93-16955# Rome Univ. (Italy). Dipt. di Fisica.
C-INTEGRABLE NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS IN N + 1 DIMENSIONS
F. Calogero (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 28 Oct. 1991 28 p
(Preprint-833; ETN-93-92936) Avail: CASI HC A03/MF A01

Two techniques to obtain nonlinear partial differential equations in N + 1 dimensions are presented. A C-integrable nonlinear partial differential equation is a nonlinear partial differential equation solvable by appropriate change of variables. Construction techniques and examples of C-integrable equations in one, two, and three dimensions are given. A method based on a change of dependent variable and another based on a change of independent variables are shown. The study shows the first method produces suitable and general equations. The second method provides partial differential equations adapted to the application of 'reduction techniques'. ESA

N93-16956# Rome Univ. (Italy). Dipt. di Fisica.
VERTEX OPERATOR REPRESENTATION OF SOME QUANTUM TORI LIE ALGEBRAS
M. Golenishcheva-Kutuzova (Army Electronic Proving Ground, Fort Huachuca, AZ.) and D. Lebedev (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 28 Oct. 1991 15 p Sponsored in part by Istituto Nazionale di Fisica Nucleare, and Karlsruhe Univ., Germany
(Preprint-834; ETN-93-92937) Avail: CASI HC A03/MF A01

The trigonometric Lie subalgebras are defined in X(sub infinity) = A(sub infinity)(B(sub infinity), C(sub infinity), D(sub infinity)). The representation is a generalization of Sin-Lie algebra. The embedding formulas into X(sub infinity) are given. These algebras can be considered as some Lie algebras of quantum tori. An irreducible representation of A, B series of trigonometric Lie algebras is constructed. The trigonometric Lie algebras, considered as a quantum (Weyl-Moyal) deformation of the Kac-Moody algebras, are considered. ESA

N93-16958# Rome Univ. (Italy). Dipt. di Fisica.
BOSE REALISATION OF A NONCANONICAL HEISENBERG ALGEBRA
G. Brodimas (Patras Univ., Greece), A. Jannussis (Patras Univ., Greece), and R. Mignani (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 3 Dec. 1991 5 p
(Preprint-844; ETN-93-92946) Avail: CASI HC A01/MF A01

The Bose realization of a generalized Heisenberg algebra is discussed. The bracket of the annihilation and creation operators is proportional to a polynomial function of the number operator. The eigenvalues of the corresponding oscillator are derived in a special case. The connection between non canonical computations relations and q algebras is stressed. ESA

N93-16967# Rome Univ. (Italy). Dipt. di Fisica.
INTEGRABLE CELLULAR AUTOMATA
M. Bruschi (Istituto Nazionale di Fisica Nucleare, Rome, Italy), M. Santini (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and O. Ragnisco (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 27 Feb. 1992 22 p
(Preprint-869; ETN-93-92969) Avail: CASI HC A03/MF A01

A general procedure to associate hierarchies of cellular automata with given spectral problems is presented. The discrete Schroedinger problem is chosen as an example. For these cellular automata, a countable number of constants of motion are constructed, using standard spectral techniques. Numerical experiments showing interesting dynamical features and particle content are performed. Other cellular automata characterized by a very rich particle content and by the existence of constants of motion are included. ESA

N93-16990# Los Alamos National Lab., NM.
AN ALGEBRAIC FOUNDATION FOR FORTRAN 90 COMMUNICATION INTRINSICS
L. Stiller 1992 11 p Presented at the Working Conference on Architecture and Compilation Techniques for Fine and Medium Grain Parallelism, Orlando, FL, 20-22 Jan. 1993
(Contract W-7405-eng-36)
(DE92-040393; LA-UR-92-2511; CONF-930129-1) Avail: CASI HC A03/MF A01

This paper proposes linear algebra and multilinear algebra as a foundation for the implementation and the understanding of several fundamental parallel communication operations. We will analyze three representative operations: the FORTRAN 90 intrinsic SPREAD, the FORTRAN 90 intrinsic SUM, and the parallel prefix operator SCAN. By formulating the operations as linear transformations, we hope to be able to apply linear algebraic techniques to reorder and to factor both these transformations and higher level user functions that call these primitives. Several applications of this technique will be discussed. Perhaps the most surprising was simple code that sped up the SPREAD intrinsic on the CM-200 by a factor of up to 6 and the SUM intrinsic by a factor of up to 20. This speedup had immediate and dramatic impact on many parallel programs. The SUM intrinsic was also sped up on the CM-5. DOE

N93-16994# Rome Univ. (Italy). Dipt. di Fisica.
LIE POINT SYMMETRIES AND EXACT SOLUTIONS OF NONLINEAR DIFFERENTIAL EQUATIONS
P. Winternitz (Montreal Univ., Quebec) 11 Nov. 1991 10 p Presented at 2d International Wigner Symposium, Gosslan, Germany, Jul. 1991 Sponsored in part by Canadian Natural Sciences and Engineering Research Council, and FCAR
(Preprint-840; ETN-93-92942) Avail: CASI HC A02/MF A01

A review of a general method for obtaining exact analytic solutions of nonlinear partial differential equations is presented. The method of symmetry reduction for partial differential equations is applied. Two physical applications are presented. One is a solution of the stimulated Raman scattering equations, the other is a classification of variable coefficient Korteweg-de Vries equations according to their Lie point symmetry groups. The Lie group theory is the only tool available for obtaining analytic exact solutions for most nonlinear partial differential equations. ESA

N93-16995# Rome Univ. (Italy). Dipt. di Fisica.
SYMMETRY GROUP OF PARTIAL DIFFERENTIAL EQUATIONS AND OF DIFFERENTIAL DIFFERENCE EQUATIONS: THE TODA LATTICE VERSUS THE KORTEWEG-DE VRIES EQUATION
D. Levi (Istituto Nazionale di Fisica Nucleare, Rome, Italy) and M. A. Rodriguez (Universidad Complutense, Madrid, Spain) 28 Nov. 1991 4 p Sponsored in part by Italian Ministry of Public Education; Istituto Nazionale de Fisica Nucleare; CICYT; Comunidad Autonoma de Madrid; and NATO
(Preprint-841; ETN-93-92943) Avail: CASI HC A01/MF A01

The symmetry group of the continuous transformations of the Toda lattice is correlated to that of the Korteweg-de Vries equation. By taking into account the continuous limit of the Toda, the four parameter symmetry group of the Toda is contained in that of the Korteweg-de Vries equation. By an inverse process, discretization of the symmetry group of the Korteweg-de Vries, a discrete element of the symmetry group of the Toda lattice is found, which gives, by symmetry reduction, its soliton solution. The one parameter transformations for the potential Korteweg-de Vries equation are considered. The analysis of the relation between continuous point transformations of partial differential equations and difference differential equations gives, from the partial differential equations, discrete symmetries of the difference differential equations. ESA

N93-16997# Rome Univ. (Italy). Dipt. di Fisica.
SYMMETRIES AND CONDITIONAL SYMMETRIES OF DIFFERENTIAL-DIFFERENCE EQUATIONS
D. Levi (Istituto Nazionale di Fisica Nucleare, Rome, Italy) and P. Winternitz (Montreal Univ., Quebec) 22 Jan. 1992 25 p Sponsored in part by Canadian Natural Sciences and Engineering Council; FCAR; NATO; and Istituto Nazionale di Fisica Nucleare
(Preprint-858; ETN-93-92960) Avail: CASI HC A03/MF A01

Two different methods of finding Lie point symmetries of differential difference equations are presented and applied to the two dimensional Toda lattice. Continuous symmetries are combined with discrete ones to obtain various reductions to lower dimensional equations, in particular to differential equations of the delay type. The concept of conditional symmetries is extended from purely differential to differential difference equations and shown to incorporate Baecklund transformations. The symmetry algebra of the two dimensional Toda system using the 'differential equation' method is presented. The results coincide with the one obtained by the intrinsic method. The symmetry reduction and conditional symmetries for differential difference equations are discussed. ESA

N93-17013# Rome Univ. (Italy). Dipt. di Fisica.
INTEGRABLE SINGULAR INTEGRAL EVOLUTION EQUATIONS
Paolo Maria Santini (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 24 Apr. 1992 36 p Submitted for publication
(Preprint-880; ETN-93-92980) Avail: CASI HC A03/MF A01

Integro-Differential Evolution Equations (IDEE's) are investigated. Scalar Riemann-Hilbert problems in the strip, a necessary background for all the results, are studied. The Riemann-Hilbert problems are used as 'change of variables' to generate and solve singular integral evolution equations. IDEE integrable by Inverse Scattering Transform (IST) are presented. The IST formalism of the Intermediate Long Wave (ILW) and the Benjamin-Ono equations are discussed. The IST formalism of a singular integral version of the AKNS class is reviewed. Other relevant examples of IDEE integrable by IST are given. Algebraic and geometrical properties of IDEE are discussed. The zero curvature representation of the ILW(sub n) class in terms of pseudodifferential operators is presented. The theory of recursion operators and bi-Hamiltonian structures are applied to the nonlocal AKNS and ILW hierarchies. An algebraic equivalence is established between relevant examples of singular integral evolution equations and discrete systems. ESA

N93-17071# Rome Univ. (Italy). Dipt. di Fisica.
A METHOD TO GENERATE INTEGRABLE NONLINEAR EQUATIONS OF THE DIRAC-TYPE AND THEIR N-SOLITON SOLUTIONS
J. Hronek (Joint Inst. for Nuclear Research, Dubna, USSR) and V. Makhankov (Istituto Nazionale di Fisica Nucleare, Rome, Italy) Jan. 1992 7 p
(Preprint-851; ETN-93-92953) Avail: CASI HC A02/MF A01

A method of delinearization to generate integrable nonlinear Schroedinger type equations along with their 'N soliton solutions' is extended to include 1 + 1 dimensional equations of the Dirac type. The aim is to construct relativistic nonlinear integrable models associated with the Dirac operator together with some of their solutions. This approach can be given in a very simple and closed form without applications to this theory. The approach is also effective in the cases where the methods of the conventional inverse spectral transform or the Riemann problem fail. ESA

N93-17220# Rome Univ. (Italy). Dipt. di Fisica.
INTEGRABLE NONLINEAR EVOLUTION EQUATIONS WITH CONSTRAINTS: 1
P. M. Santini (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 25 Sep. 1991 18 p Sponsored in part by Italian Ministry of Public Education
(Preprint-824; ETN-93-92928) Avail: CASI HC A03/MF A01

A method to construct classes of integrable nonlinear evolution equations in n + 1 dimensions with constraints is presented. The constraint is given by a set of, in general nonlinear, equations and is equivalent to a generalized commutativity condition for a finite number of linear operators. Examples of nonlinear evolution equations with constraints are generated. Some of them are integrable through a change of variables. Integration using the ideas of the dressing method is carried out. ESA

N93-17361# California Univ., Berkeley. Lawrence Berkeley Lab.
A BOLTZMANN-EQUATION APPROACH TO THE MAGNETORESISTANCE OF FERROMAGNETIC-NORMAL METALLIC MULTILAYERS
L. M. Falicov and R. Q. Hood Jun. 1992 14 p Presented at the Symposium on Magnetic Ultrathin Films, Multilayers, and Surfaces, Lyon, France, 7-10 Sep. 1992
(Contract DE-AC03-76SF-00098)
(DE92-041213; LBL-32483; CONF-9209227-1) Avail: CASI HC A03/MF A01

The Boltzmann equation is solved for a system consisting of a ferromagnetic-normal-ferromagnetic metallic trilayer. The in-plane conductance of the film is calculated for two configurations: the ferromagnetic layers aligned (1) parallel and (2) antiparallel to each other. The results explain the giant negative magnetoresistance encountered in these systems when an initial antiparallel arrangement is changed into a parallel configuration by application of an external magnetic field. A large negative magnetoresistance requires, in general, considerable asymmetry in the interface scattering for the two spin orientations. DOE

N93-17473# Japan Atomic Energy Research Inst., Tokyo.
NUMERICAL EVALUATION OF GENERAL n-DIMENSIONAL INTEGRALS BY THE REPEATED USE OF NEWTON-COTES FORMULAS
Takeshi Nihira (Ibaraki Univ., Hitachi, Japan) and Tadao Iwata Jul. 1992 34 p
(DE93-715528; JAERI-M-92-099) Avail: CASI HC A03/MF A01

The composites Simpson's rule is extended to n-dimensional integrals with variable limits. This extension is illustrated by means of the recursion relation of n-fold series. The structure of calculation by the Newton-Cotes formulas for n-dimensional integrals is clarified with this method. A quadrature formula corresponding to the Newton-Cotes formulas can be readily constructed. The results computed for some examples are given, and the error estimates for two or three dimensional integrals are described using the error term. DOE

N93-17489# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
FINE-GRAIN INCREMENTAL IMPLEMENTATION OF ALGEBRAIC SPECIFICATIONS
E. A. vanderMeulen Dec. 1991 26 p Sponsored in part by EEC, and Netherlands Organization for Scientific Research

(CWI-CS-R9159; ETN-92-92500) Copyright Avail: CASI HC A03/MF A01

Considering symbol tables as aggregate values often forms an obstacle to incremental type checking or evaluation of programs. A small change in a symbol table requires many expensive recalculations of values that depend on (part of) the symbol table. An incremental implementation was previously derived from algebraic specifications belonging to the subclass of well presented primitive recursive schemes. Type check specifications typically belong to this class. This incremental implementation method is generalized to functions on values of auxiliary data types like symbol tables. Thus, fine grain incremental implementations are obtained. This fine grain incrementality can be derived from a subclass of algebraic specifications called layered primitive recursive schemes. ESA

N93-17494# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France). Equipe Decentralization Hierarchisation, Parallelisme.
PERFORMANCE AND STABILITY ROBUSTNESS FOR UNCERTAIN LINEAR SYSTEMS: A QUADRATIC APPROACH Ph.D. Thesis - Inst. National des Sciences Appliquees
Denis Arzelier 1992 151 p In FRENCH
(LAAS-92199; ETN-92-92549) Avail: CASI HC A08/MF A02

The robust control of continuous uncertain linear dynamical systems, described by state space equations, is investigated. The robust control problem is studied via the concept of quadratic stabilizability which states the existence of a quadratic Lyapunov function for the system. The performance robustness is discussed by using the root clustering of the closed loop system in a sector of the left half plane. The problem of robust control via output feeback is studied. Static and dynamic output feedback were studied. Another class of linear models was considered: singular systems. Stabilization procedures were developed in the certain case and some robustness elements were introduced on uncertain models. ESA

N93-17536# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
A REWRITE APPROACH TO POLYNOMIAL IDEAL THEORY
Aart Middeldorp and Mirjana Starcevic (Vrije Univ., Amsterdam, Netherlands) 19 Dec. 1991 31 p
(CWI-CS-R9160; ETN-92-92501) Copyright Avail: CASI HC A03/MF A01

A self contained introduction is given to the theory of Groebner bases which provide algorithmic solutions to many problems in polynomial ideal theory. The basic theory of Groebner bases is explained from a term rewriting point of view, and by abandoning the usual distributive normal form, representation of polynomials is shown to lead to a considerable simplification of the theory. ESA

N93-17553# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
MULTIGRID FOR SEMICONDUCTOR DEVICE SIMULATION: CELL-CENTERED OR VERTEX-CENTERED MULTIGRID?
J. Molenaar Dec. 1991 22 p
(CWI-NM-R9118; ETN-92-92504) Copyright Avail: CASI HC A03/MF A01

The study of primal and dual mixed finite element discretization on rectangular grids for the semicondutor device equations is reported. When suitable quadrature rules are used, the primal version is equivalent to the usual vertex centered box scheme, whereas the dual version leads to a cell centered finite volume discretization. In both cases the system of nonlinear equations obtained after discretization is solved for multigrid. A cell centered multigrid was used for the cell centered scheme and a vertex centered multigrid was used for the vertex centered scheme. In cell centered multigrid it is necessary to apply a local damping of the restricted residual in order to deal with the strong nonlinearity of the problem. This can be avoided by using the vertex centered multigrid algorithm provided that injection is used for the restriction of the residual. Injection is usually too inaccurate a grid transfer operator for second order differential equations, but by means of a two grid analysis it was shown that the choice of a suitable smoothing operator can alleviate this problem. In numerical experiments vertex centered multigrid appears to be more efficient and robust for solving semiconductor equations than cell centered multigrid. ESA

N93-17555# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
ON THE HISTORY OF THE FUNCTION M(x)/(SQUARE ROOT OF x) SINCE STIELTJES
H. J. J. teRiele Dec. 1991 15 p Submitted for publication
(CWI-NM-R9120; ETN-92-92506) Copyright Avail: CASI HC A03/MF A01

M(x) usually denotes the function which counts the difference between the number of squarefree positive integers less than or equal to x with an even and those with an odd number of prime factors. It is known that the boundedness of M(x)/(square root of x) would imply the truth of the Riemann hypothesis. Stieltjes was one of the very first who studied M(x) and tried to prove the boundedness of M(x)/(square root of x). The historical developments since Stieltjes are traced. These now point in the direction of the unboundedness of this function. The best results proved so far are that there exists an x for which M(x)/(square root of x) is greater than 1.06 and another x for which M(x)/(square root of x) is less than -1.009. ESA

N93-17556# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
ON SOLVING THE DIOPHANTINE EQUATION (x CUBED) + (y CUBED) + (z CUBED) = k ON A VECTOR COMPUTER
D. R. Health-Brown (Oxford Univ., England), W. M. Lioen, and H. J. J. teRiele Dec. 1991 13 p
(CWI-NM-R9121; ETN-92-92507) Copyright Avail: CASI HC A03/MF A01

A new algorithm for solving the Diophantine equation x(sup 3) + y(sup 3) + z(sup 3) = k, where k is a given non zero integer is proposed. Detailed versions of this algorithm for various chosen values of k are presented. Details of how the algorithms were implanted on the Cyber 205 vector computer and the results obtained are given. In particular the vectorization of the computations of 1/(b(sup 2) - ac) mod n is described. The double precision arithmetic operations, which were necessary because of the size of the numbers handled, were vectorized. The results of computations are listed. No (new) solutions were found for k = 3, 30, and 42. For k = 2 the first solution was found which is not of the parametric form given above. For k = 20, eight new solutions were found and, finally, for k = 39 one solution was found, so this case can be removed from the list of values of k for which no solution is known. ESA

N93-17558# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
SOLVING LARGE DENSE SYSTEMS OF LINEAR EQUATIONS ON SYSTEMS WITH VIRTUAL MEMORY AND WITH CACHE
Walter M. Lioen and Dik T. Winter Dec. 1991 15 p
(CWI-NM-R9123; ETN-92-92509) Copyright Avail: CASI HC A03/MF A01

The problem of solving large full sets of linear equations on a computer with hierarchical memory is considered. Blocked Gaussian elimination and QR factorization are studied in an attempt to apply exactly the same implementations on computers with virtual memory as on computers with cache. This differs sightly from the LAPACK (a portable linear algebra library for high performance computers) approach which although aimed at the same architectures, focuses mainly on computers with vector registers and/or cache. Experiments on a Cyber 205 and an Alliant FX/4 are reported. ESA

N93-17587# Technische Univ., Delft (Netherlands).
THE HAHN-EXTON q-BESSEL FUNCTION Ph.D. Thesis
Rene Francois Swarttouw 1992 98 p
(ISBN-90-9004649-6; ETN-92-92531) Avail: CASI HC A05/MF A02

A q-analog of the Bessel function is studied. This function was introduced by Hahn and Exton as the solution of a special basic Sturm-Liouville equation. Exton also derived a generating function and some recurrence and difference recurrence relations for this function. Vaksman and Korogodskii implicitly gave some orthogonality relations for this function. The classical results concerning the Bessel function are generalized and a survey on q-theory and some known results is presented. The results that Exton found and some new results are given. The two orthogonality relations are stated explicitly and are proved. The q-analog of the Bessel differential equation is studied. A second solution, which is a q-analog of the classical

Y(sub nu) is discussed. Basic analogs of some integral transforms are considered. Q-analogs of the Hankel transform, the Fourier sine and Fourier cosine transform, are derived. Three q-extensions of addition formulas are discussed. Two are generalizations of Graf's additional theorem, and the third is an extension of Gegenbauers addition formula. ESA

N93-17591# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.

A CONTRIBUTION TO THE THEORY AND PRACTICE OF MULTIVARIATE SPLINES Ph.D. Thesis

Marian Neamtu 1991 164 p Sponsored by Netherlands Organization for Scientific Research, and Netherlands Foundation of Mathematics

(ISBN-90-9004534-1; ETN-92-92535) Avail: CASI HC A08/MF A02

Theoretical and practical aspects of multivariate splines and related topics from the constructive approximation theory are studied. The notion of polyhedral splines is introduced and known results are given. The interpolation of scattered data, Bernstein-Bezier representation over triangular partitions, and geometric continuity, are introduced. Shape preserving approximation is addressed. Multivariate simplex splines are studied: the notion of multivariate divided difference and a relation with multivariate simplex splines are established; certain recurrence relations for simplex splines are derived; the notion of discrete simplex spline is introduced and a subdivision scheme for the evaluation of simplex splines is proposed. Similar questions are studied for Bernstein polynomials. The interpolation of data scattered in the three dimensional Euclidean space is studied. A number of problems of shape preserving approximation are derived. ESA

N93-17593# Leiden Univ. (Netherlands). Dept. of Mathematics and Computing Science.

THE ERROR COMMITTED BY STOPPING NEWTON ITERATION IN THE NUMERICAL SOLUTION OF STIFF INITIAL VALUE PROBLEMS

J. L. M. vanDorsselaer and M. N. Spijker Mar. 1992 30 p Sponsored by Netherlands Organization for Scientific Research

(TW-92-02; ETN-92-92536) Avail: CASI HC A03/MF A01

The numerical solution of initial value problems, for nonlinear ordinary differential equations, by step by step methods that are implicit, is addressed. For non stiff problems fixed point iteration, also called Picard iteration, is a classical process for solving the system of (algebraic) equations occurring in each time step of such step by step methods. The order of the error committed by stopping this process, after a fixed number of iteration steps, is well understood. For stiff problems it is common practice to use Newton iteration, or a variant thereof, instead of Picard iteration. The stopping error for such Newton type iterations is analyzed with the aim of understanding this error, that is comparable to the insight one for the case of Picard iteration. The error committed by stopping Newton type iteration, after a specified number of iteration steps, is estimated and related to the pure discretization error of the underlying step by step method. The question of existence and uniqueness of solutions to the system of (algebraic) equations is studied. All conclusions are relevant to nonlinear problems that may be arbitrarily stiff. The estimates obtained for these problems reflect order reduction phenomena, in the presence of stiffness, confirmed by numerical experiments. The focus is on linear multistep methods and Runge-Kutta methods, but part of the conclusions are also relevant to other situations. ESA

N93-17633# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Signal Processing and Computer Technology.

ERROR FEEDBACK FOR REDUCTION OF QUANTIZATION ERRORS DUE TO ARITHMETIC OPERATIONS IN RECURSIVE DIGITAL FILTERS Ph.D. Thesis

Timo I. Laakso 1991 66 p Sponsored by German Academic Exchange Service and Antti Wihuri Foundation

(EL-9; ISBN-951-22-0766-4; ETN-92-92614) Avail: CASI HC A04/MF A01

The reduction of quantization errors due to arithmetic operations in recursive digital filters is studied. The treatment of error feedback is provided and the concept is related to the theory of optimal filtering and nonlinear feedback systems. The implementation of error feedback with signal processors is investigated. The suppression of both stochastic roundoff noise in normal filtering operation and the autonomous oscillations is considered. Mathematical models for the quantization errors in both cases are investigated. Fixed point and floating point arithmetic are discussed. The optimal error feedback coefficients for minimum fixed point roundoff noise at the filter output are formulated as a solution to a Toeplitz system of linear equations. Optimal error feedback is shown to be a special application of Wiener filtering. Implementations for suboptimal error feedback using symmetric or power of two coefficents are shown. The stability criterion of Tsypkin is applied to digital filters designed with a single magnitude truncation or rounding quantizer with error feedback. Second order filter structures are analyzed. It is shown that low roundoff noise and the absence of limit cycles can be attained at the same time. The elimination of overflow oscillations in recursive filters provided with one saturation nonlinearity and overflow error feedback is considered. By applying the criterion of D. Mitra, the solution for the error feedback coefficients is formulated. Optimal error feedback is formulated for floating point recursive filters and shown to be equivalent to the corresponding fixed point implementation. The elimination of limit cycles in floating point recursive filters is studied. It is concluded that error feedback is a powerful and flexible method for suppressing quantization errors in implementations of recursive digital filters. It is well suited for use in signal processors. The results can directly be applied to implement well behaved recursive digital filters. ESA

N93-17664# Iowa Univ., Iowa City.

PROCEEDINGS OF THE 2ND INTERNATIONAL CONFERENCE ON ALGEBRAIC METHODOLOGY AND SOFTWARE TECHNOLOGY

25 May 1992 342 p Conference held in Iowa City, IA, 22-25 May 1991 (Contract N00014-90-J-1836)

(AD-A257487) Avail: CASI HC A15/MF A03

Boolean logic treats disjunction and conjunction symmetrically and algebraically. The corresponding operations for computation are respectively nondeterminism (choice) and concurrency. Petri nets treat these symmetrically but not algebraically, while event structures treat them algebraically but not symmetrically. Here we achieve both via the notion of an event space as a poset with all nonempty joins representing concurrences and a top representing the unreachable event. The symmetry is with the dual notion of state space, a poset with all nonempty meets representing choices and a bottom representing the start state. The algebra is that of a parallel programming language expanded to the language of full linear logic, Girard's axiomatization of which is satisfied by the event space interpretation of this language. Event spaces resemble vector spaces in distinguishing tensor product from direct product and in being isomorphic to their double dual, but differ from them in distinguishing direct product from direct sum and tensor product from tensor sum. GRA

N93-17712# Rome Univ. (Italy). Dipt. di Fisica.

TIME EVOLUTION OF CALDIROLA-KANAI OSCILLATORS

S. Baskoutas (Patras Univ., Greece), A. Jannussis (Patras Univ., Greece), and R. Mignani (Institute for Basic Research, Palm Harbor, FL.) 3 Dec. 1992 13 p

(Preprint-846; ETN-93-92948) Avail: CASI HC A03/MF A01

The time evolution of open quantum systems driven by Hamiltonians of the Caldirola-Kanai (CK) type is discussed. The Schreodinger scheme is applied. The usual CK Hamiltonian, the inverted one, and the CK Hamiltonian with complex friction coefficients, are considered. The approach is based on the Lie admissible treatment of non Hermitian Hamiltonians and on the Wei-Horman expression of the time development operator. The explicit expressions of the CK propagators are derived. By passing to Bloch statistics, the density matrix and the main thermodynamic quantities of the imaginary friction CK oscillator are obtained. ESA

N93-17713# Amsterdam Univ. (Netherlands). Dept. of Philosophy.

SEMANTICS AND COMPARATIVE LOGIC

Arthur Nieuwendijk Nov. 1991 43 p Submitted for publication

(LP-91-09; ETN-93-93101) Avail: CASI HC A03/MF A01

Study on 'situation semantics' is presented. A general discussion on a formal interpretation of Navyanyaya logic is given with focus on the notion of 'jnana'. An interpretation of this notion as a preliminary to a comparison of Navyanyaya logic and situation semantics with respect to the representation of mental states and the role assigned to these in the analysis of inference is provided. Attention is given to the notion of 'vyapti', in particular to the conditions on the grounds of which the acceptance of a vyapti relation is justified. The inference scheme as maintained by the

Navyanaiyayikas is addressed: a proposal for an interpretation, for which insights and devices are derived from a situation semantical framework is given. ESA

N93-17715# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.

LAMBEK GRAMMAR: AN INFORMATION-BASED CATEGORICAL GRAMMAR

Victor SanchezValencia Jan. 1992 36 p

(LP-92-01; ETN-93-93103) Avail: CASI HC A03/MF A01

Lambek Grammar (LG) is presented and partially illustrated. LG is a nondirected categorical grammar in which string generation and type combination are intimately connected in that it is one process which combines types and generates strings. The grammar is specifically designed for the regulated transmission of 'grammatical' information between semantical types and strings. LG contains principles guiding the transmission of information from the semantical types into the strings, and contains principles regulating the flow of information from the strings into the semantic types themselves. An intrinsic motivation therefore holds for setting up LG, since it is believed that this system is a convenient vehicle for the representation of temporal meaning. An initial orientation of the advantages of LG is offered by example of its practical utility: the use of LG to overcome the linguistic infelicity of the nondirected Lambek calculus. ESA

N93-17716# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.

MODAL LOGIC AND ATTRIBUTE VALUE STRUCTURES

Patrick Blackburn Mar. 1992 35 p Sponsored by United Kingdom Science and Engineering Research Council

(LP-92-02; ETN-93-93104) Avail: CASI HC A03/MF A01

The relationship between various languages of modal logic and an approach to the specification and processing of natural language grammars currently popular in computational linguistics is examined. This approach is the use of Attribute Value (AV) formalisms. The main aims are to show that the most common formalisms are nothing but languages of propositional modal logic, and to establish the basic logical theory of the languages concerned. The AV approach to grammar is reviewed with discussion of the concepts of attributes, values and unification, in terms of AV matrices and in terms of certain labeled decorated graphs. From this discussion AV structures emerge as being essentially a certain type of Kripke model. Thus AV structures can be described using propositional modal logic; the key assertion of the study is that this is what computational linguists do. AV matrices are noted to directly correspond to wffs of the language L, the simplest modal language for talking about AV structures. Basic logical properties of L are sketched and a technique used for establishing decisions is outlined. AV matrices augmented by 'boxlabels' are considered, and turn out to amount to wffs in the modal language L(sup N), which is L augmented by nominals. Results concerning L(sup N) are noted. The interface language of the PATR2 system is considered and it is shown how the modal language L(sup KR) can be abstracted from it. ESA

N93-17725# Amsterdam Univ. (Netherlands). Center for Computer Science in Organization and Management.

THE SCHOENMAKER'S PARADOX: ITS SOLUTION IN A BELIEF DEPENDENCE FRAMEWORK

Zhisheng Huang and Peter vanEmdeBoas Sep. 1991 15 p

(LP-91-05; ETN-93-93097) Avail: CASI HC A03/MF A01

An important problem concerning knowledge acquisition raised by Schoenmaker is addressed. There may arise some unacceptable but hard perceivable results in knowledge bases if the knowledge bases assimilate information from multiple expert sources. The Schoenmakers paradox is reexamined in the framework of belief dependence for multiple agent environments. The notion of safe assimilating is introduced to capture a better understanding of the problem. Based on the logic of belief dependence, an 'almost safely and soundly assimilating' operation, which is argued to be a reasonable and acceptable strategy for the problem, is introduced. ESA

N93-17727# Amsterdam Univ. (Netherlands). Center for Computer Science in Organization and Management.

BELIEF DEPENDENCE, REVISION AND PERSISTENCE

Zhisheng Huang and Peter vanEmdeBoas Sep. 1991 13 p

(LP-91-06; ETN-93-93098) Avail: CASI HC A03/MF A01

A rational formalism which makes the choice between belief revision and belief persistence computable is presented. A rational agent, when confronted with information inconsistency with his beliefs will either revise his beliefs in order to incorporate this new information, or persist in his beliefs and reject this information. A less rational agent even may revise his beliefs without there being a real conflict with the new information. A rational balance strategy between belief revision and belief persistence in a multiple agent environment is proposed based on the framework of logic of belief dependence. The proposed strategy, called the 'confidence priority strategy', has the impact that the more confidently a formula is believed by an informant, the more credible the belief is. The strategy is plausible for cooperative multiple agent environments. The distinct roles played by the agents are determined in order to capture an intuitive understanding of the strategy. ESA

N93-17735# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.

A GENERALIZED ASYMPTOTICITY PROBLEM IN MAX ALGEBRA; THE TWO-DIMENSIONAL CASE

J. G. Braker and J. A. C. Resing (Technische Univ., Eindhoven, Netherlands) 1992 20 p

(Rept-92-29; ETN-93-93121) Copyright Avail: CASI HC A03/MF A01

The asymptotic behavior of an algorithm in max algebra, which can be seen as an extension of the concept of periodicity, is discussed. This concept of periodicity means that for every irreducible matrix M, M(sup(n + d) = lambda(sup d)M(sup n) in max algebra sense, for n greater than or equal to n(sub 0). Here lambda is the eigenvalue and d denotes the length of the critical circuit. The main result is that the asymptotic behavior of the algorithm is characterized by one or more critical circuits, and that two cases can be distinguished. In the first case, the generalized critical circuit has length two, and generalized order 2 periodicity is found. In the second case, the two generalized critical circuits are of length one, and generalized order 1 periodicity is stated. Only the case of 2 by 2 matrices is treated. It is expected that the treatment of this specific case will lead to a more general set up in which square matrices of any size can be included. This extension seems to be such that the asymptotic behavior is order d periodic in a generalized way, where d is the least common multiple of the lengths of some of the generalized critical circuits. ESA

N93-17758# Superconducting Super Collider Lab., Dallas, TX.

CONSTANT OF MOTION, HAMILTONIAN, AND LAGRANGIAN FOR AUTONOMOUS SYSTEMS DEFINED IN A HYPERBOLIC FLAT SPACE

G. Lopez Sep. 1992 10 p

(Contract DE-AC35-89ER-40486)

(DE93-002046; SSCL-Preprint-150) Avail: CASI HC A02/MF A01

The Lagrangian, the Hamiltonian, and the Generalized Linear Momentum of an autonomous dynamical system defined in a hyperbolic flat space are studied in terms of a constant of motion associated with this system. Some restrictions in the symmetry of the Lagrangian are required in order for the Euler-Lagrange equations to be satisfied. The one-dimensional relativistic motion is given as an example of the approach. DOE

N93-17781# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.

FINITE TYPE STRUCTURES WITHIN COMBINATORY ALGEBRAS

Inge Bethke Apr. 1991 28 p

(ML-91-06; ETN-93-93084) Avail: CASI HC A03/MF A01

Inside a Combinatory Algebra (CA) there are 'internal' versions of the finite type structure over omega, which form models of various systems of finite type arithmetic. A study comparing internal representations of the intentional and extensional functionals is presented. If these classes coincide, the algebra is called ft-extensional. Some criteria for ft-extensionality are given and a number of well known CA's are shown to be ft-extensional, regardless of the particular choice of representation for omega. In particular, D(sub A), P(sub omega), T(sup omega), H(sub Omega), and certain D(sub infinity) models, all share the property of ft-extensionality. It is also shown that ft-extensionality is by no means an intrinsic property of CA's: that there exists a very concrete class of CA's, the class of reflexive coherence spaces, no member of which has this property. This leads to a comparison

of ft-extensionality with the well studied notions of extensionality and weak extensionality. Ft-extensionality turns out to be completely independent.
ESA

N93-17784# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
MODAL DERIVATION RULES
Yde Venema Jun. 1991 40 p
(ML-91-07; ETN-93-93085) Avail: CASI HC A03/MF A01

The non-xi rule is defined as a derivation rule for multi-modal logics. This rule is a generalized version of Gabbay's irreflexivity rule. A meta-theorem on completeness of the following kind is proved: if Lambda is a derivation system having a set of axioms that are special Sahlqvist formulas, and Lambda(sup +) is the extension of Lambda with a set of non xi rules, then Lambda(sup +) is strongly sound and complete with respect to a class of frames determined by the axioms and the rules.
ESA

N93-17786# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
GOING STABLE IN GRAPH MODELS
Inge Bethke Jul. 1991 16 p
(ML-91-08; ETN-93-93086) Avail: CASI HC A03/MF A01

A procedure for depleting graph models in a way such that the representable functions are exactly the stable ones is given. Some well known notions and facts concerning coherence spaces are given. The notion of a stable graph model is rendered precisely and it is shown that although the universe may be heavily depleted, one still ends up with a model for the untyped Lambda calculus. The question of existence of stable graph models for arbitary embeddings is addressed. Here, the key notion is the notion of a meager set. A construction procedure for stable graph models from meager sets is described.
ESA

N93-17792# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
A NOTE ON THE DIAGONALIZABLE ALGEBRAS OF PA AND ZF
V. Y. Shavrukov Aug. 1991 27 p
(ML-91-09; ETN-93-93087) Avail: CASI HC A03/MF A01

A proof that the diagonalizable algebras of PA and ZF are not isomorphic is presented. A number of auxiliary notions are introduced and a number of lemmas are formulated in carrying out the proof. The lemmas are well known and/or easy to believe. The Kalmar elementary functions are chosen as a class of functions of negligibly slow growth elements, to be used as small change, since the proof is to deal with rates of growth of functions. In the given theorem, the PA and ZF pair of theories can be replaced by a wide set of others. The conditions in the two theories under which this replacement is possible are brought together.
ESA

N93-17794# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
SAHLQVIST'S THEOREM FOR BOOLEAN ALGEBRAS WITH OPERATORS
Maarten deRijke and Yde Venema Sep. 1991 15 p Sponsored in part by Netherlands Organization for Scientific Research
(ML-91-10; ETN-93-93088) Avail: CASI HC A03/MF A01

A study aimed at showing how a well known result from modal logic, Sahlqvist's theorem, can be applied to the theory of boolean algebras with operators to obtain a large class of identities, called Sahlqvist identities, that are preserved under canonical embedding algebras, is presented. The modal counterparts of given Sahlqvist equalities are described, and a Sahlqvist theorem, which says that Sahlqvist formulas are both canonical and first order, is partially proved. From this, the preservation of Sahlqvist equalities under canonical embedding algebras is derived. A demonstration of the usefulness of the Sahlqvist theorem, showing that by the Sahlqvist theorem the equivalence of two equations may be proved or disproved by reasoning on modal frames (or atom structures) rather than by manipulating these equations themselves, is given; as an example illustrating this method, Henkin's equation in cylindrical algebras is proved to be equivalent to an equality of a simpler form.
ESA

N93-16763*# University of South Florida, Tampa. Dept. of Civil Engineering and Mechanics.
THE ROLE OF UNDER-DETERMINED APPROXIMATIONS IN ENGINEERING AND SCIENCE APPLICATION
William C. Carpenter *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 79-86 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

N93-16779*# Wichita State Univ., KS. Dept. of Industrial Engineering.
FUZZY SET APPROACH TO QUALITY FUNCTION DEPLOYMENT: AN INVESTIGATION Abstract Only Final Report
Abu S. M. Masud *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 142 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

N93-17300*# Auburn Univ., AL. Dept. of Electrical Engineering.
NUMERICAL METHODS FOR THE ANALYSIS OF SAMPLED-DATA SYSTEMS AND FOR THE COMPUTATION OF SYSTEM ZEROS
A. Scottedward Hodel *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17331*# Indiana Inst. of Tech., Fort Wayne. Dept. of Mechanical Engineering.
STIFFNESSES BY (TiN) ENSEMBLE MOLECULAR DYNAMICS
Patrick Tibbits *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N93-15820# New York Univ., New York. Inst. of Mathematical Sciences.
SOJOURNS, EXTREMES, AND SELF-INTERSECTIONS OF STOCHASTIC PROCESSES Final Technical Report, 1 Jul. 1989 - 30 Jun. 1992
Simeon M. Berman 1 Sep. 1992 2 p
(Contract DAAL03-89-K-0125)
(AD-A257251; ARO-26649.9-MA) Avail: CASI HC A01/MF A01

The subjects of this research are certain probabilistic properties of real and vector valued random functions X(t), where t is a generalized time parameter taking values in a subset T of Euclidean space. The distributions of three functionals of the random function X are studied. For any Borel set A in the range, the sojourn time of X in A is defined as the measure of the subset of the points t in T such that X(t) belongs to A. The self-intersection set of X is the subset of the set of points (s,t) in the product space of T such that s = t and X(s) = X(t). Finally, for a real valued random function X, the extreme value is the functional equal to the maximum value of X on the domain T. The research is concerned with the determination of the distributions of these functionals under various hypotheses about the probabilistic structure of X. It is assumed that the random function is Gaussian or Markovian.
GRA

N93-15874# Washington Univ., Saint Louis, MO. Dept. of Chemistry.
BAYESIAN INTERPOLATION AND DECONVOLUTION Final Report, Feb. 1991 - Jan. 1992
G. L. Bretthorst Jul. 1992 50 p
(Contract DAAL03-86-D-0001)
(AD-A256185; AMSMI-TR-CR-RD-AS-92-4; AD-E951886) Avail: CASI HC A03/MF A01

The deconvolution problem is addressed in stages beginning with the interpolation problem when little prior information is available and proceeding to the full deconvolution problem when a great deal of prior information is available. The results of these calculations indicate that good solutions to the deconvolution program are available even when limited prior information

is available and that these results overlap those obtained when a great deal of prior information is available. The difference between them is that the use of uninformative priors causes large uncertainties in the estimated signal, while highly informative priors decreases the uncertainties in the signal. Author (GRA)

N93-15884# Lawrence Livermore National Lab., CA.
TIME STABILITY OF MONTE CARLO DEVICE SIMULATION
P. W. Rambo and J. Denavit 29 Jun. 1992 4 p Presented at the International Electron Devices Meeting, San Francisco, CA, 6-9 Dec. 1992
(Contract W-7405-eng-48)
(DE92-019375; UCRL-JC-111062; CONF-921204-1) Avail: CASI HC A01/MF A01

We present stability analysis applicable to several algorithms used for solid state simulation including an algorithm described by Hackney. An approximate expression for the growth rate, valid for omega sub p (Delta)t less than 1 and nu sub c/omega sub p less than 1, is given, by gamma x Delta(t) approx x omega sub p x Delta(t)sq/sub 4 -nu sub c x Delta(t)/sub 2 where nu sub c is the momentum transfer collision rate. In the absence of collisions, the interesting result is found that instability occurs for all values of omega sub p x Delta(t). In practice, collisions allow stable simulation provided omega sub p x Delta(t) is sufficiently small. DOE

N93-15978# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences.
AN INITIAL MODEL OF REQUIREMENTS TRACEABILITY: AN EMPIRICAL STUDY Technical Report, Sep. 1992
Balasubramaniam Ramesh, Ann G. Abbott, Mona R. Busch, and Michael Edwards 22 Sep. 1992 71 p
(AD-A256720; NPS-AS-92-025) Avail: CASI HC A04/MF A01

A primary concern in the development of large-scale, real-time, complex, computer-intensive systems is ensuring that the system meets the specified requirements. Further, the requirements themselves evolve and undergo many changes during the development process. In such a context, it is essential to maintain traceability of requirements to various outputs to ensure that the system meets the current set of requirements. An empirical study, utilizing focus group and protocol analysis techniques, was conducted with students from the Naval Postgraduate School in a simulated systems development environment. Based on the analysis of data, this study highlights several major issues that need to be considered in the development of a model of traceability. An initial model of traceability as well as recommendations for future research to refine and validate the model are presented. GRA

N93-16216# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
A NORMAL DISTRIBUTION OR A WEIBULL DISTRIBUTION FOR FATIGUE LIVES
J. Schijve Jun. 1992 14 p
(LR-689; ETN-92-92881) Avail: CASI HC A03/MF A01

The results of six series of 18 to 30 similar fatigue tests on three types of specimens were used to check the applicability of the normal distribution function and the three parameter Weibull distribution function: unnotched, edge notched, and riveted lap joint. A least square procedure was adopted to obtain the three parameters of the Weibull function. Comments are made on the results obtained. On average, the Weibull distribution function agreed equally well or better with the test data in comparison to the normal distributiuon function. The data confirm relatively more scatter for higher endurances. The practical significance of statistical analysis of large test series should be considered with extreme caution in view of possible sources of scatter in laboratory tests, which may be irrelevant in practice. ESA

N93-16223# Universiteit Twente, Enschede (Netherlands).
STOCHASTIC INTEGRALS AND GOODNESS-OF-FIT TESTS Ph.D. Thesis
Alexander Johannes Koning 1991 179 p
(ISBN-90-9003836-1; ETN-93-92851) Avail: CASI HC A09/MF A02

The goodness of fit tests, for the simple and the composite null hypothesis, are investigated. The study is based on test statistics which summarize the behavior of the basic martingale by means of a sublinear functional T of a stochastic integral Q(sub n) with respect to the basic martingale M(sub n). Examples of sublinear functionals are the generalized rank functional T(sub R) and the supremum functional T(sub S). Special attention is given to the tests based on these two functionals, generalized rank, and supremum type tests. The theory for the simple null hypothesis is developed, starting from an empirical process approach to the approximation by means of Gaussian processes of stochastic integrals with respect to the basic martingale. The results are extended to the composite null hypothesis, by studying the behavior of a generalization of the maximum likelihood estimator, including the effect of plugging this estimator into a stochastic integral. The theory is built with tools which all relate to the tail behavior of various types of stochastic processes. The problem of testing exponentiality is addressed. The limitations to the theory with respect to sample size are investigated by means of simulation experiments. ESA

N93-16250# Stanford Univ., CA. Dept. of Electrical Engineering.
STUDIES IN ESTIMATION THEORY, APPLICATIONS, AND IMPLEMENTATION Final Report, 16 May 1989 - 15 May 1992
Thomas Kailath Sep. 1992 13 p
(Contract DAAL03-89-K-0109)
(AD-A256964; ARO-26736.36-MA) Avail: CASI HC A03/MF A01

The major problem was to extend fast algorithms based on displacement structure to matrices with zero minus the socalled singular case. Almost all the literature, of about a hundred years, deals with the socalled regular or nonsingular cases, with particular success in the case of Hankel and Hankel-related matrices. These results are related to the now wellknown Berlekamp-Massey algorithm (for solving Hankel linear equations). For Toeplitz and Toeplitz-related matrices, there were only some partial and rather complicated solutions. D. Pal gives a solution to this problem for the case of Toeplitz and quasi-Toeplitz matrices. While not as general as one would have liked, the latter class of matrices allowed one to get the first general solution to the stability and root-distribution problems for discrete-time systems. Additional results appear in the list of publications in the appendix. GRA

N93-16335# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
MODELLING WORKLOAD FOR MULTI-SERVICE LAN'S
X. Hou and I. G. Niemegeers 1992 22 p
(Memo-INF-92-31; TIOS-92/14; ETN-92-92444) Copyright Avail: CASI HC A03/MF A01

An approach to the workload modeling for multiservice Local Area Networks (LAN's) is presented. The workload is produced by different sources which represent the abstraction of various applications supported by networks. The models for three types of applications, including data communication, conversational speech, and video are given. The models are described by stochastic processes with constrained rules. Stochastic processes specify the interarrival time distribution and the distribution of destinations. The constrained rules specify various correlations between arrivals in the same station as well as in different stations. To demonstrate the approach, an example of a parameterized workload model is given for a particular multiservice LAN. The model can be used for traffic generation in simulations. ESA

N93-16356# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
RANDOM QUADRATIC FORMS AND THE BOOTSTRAP FOR U-STATISTICS
Herold Dehling and Thomas Mikosch (Eidgenoessische Technische Hochschule, Zurich, Switzerland) 1992 21 p
(W-9207; ETN-93-92837) Avail: CASI HC A03/MF A01

The bootstrap distribution for U-statistics is studied with special emphasis on the degenerate case. For the Efron bootstrap, a short proof of the consistency is given, using Mallow's metrics. An independent and identically distribution weighted bootstrap is studied. It turns out that this random quadratic form converges weakly, to a Wiener-Ito double stochastic integral. ESA

N93-16413# Rome Univ. (Italy). Dipartimento di Fisica.
RENORMALIZATION OF LATTICE TWO-FERMION OPERATORS WITH IMPROVED NEAREST-NEIGHBOUR ACTION
E. Gabrielli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), G. Martinelli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), C. Pittori (Istituto

Nazionale di Fisica Nucleare, Rome, Italy), G. Heatlie (Southampton Univ., England), and C. T. Sachrajda (Southampton Univ., England) 13 Nov. 1990 14 p Submitted for publication Sponsored in part by Ministry of University and Scientific and Technological Research and Science Research Council
(Preprint-765; SHEP-90/91-4; ETN-93-92887) Avail: CASI HC A03/MF A01

A one loop calculation of the renormalization constants of two fermion local operators with the nearest neighbor improved action is presented. This calculation is a necessary ingredient in lattice computations of continuum hadronic matrix elements relevant for predictions of physical quantities. The renormalization constant of a particular 4 fermion improved operator was calculated. The study shows that the use of improved actions, and renormalized improved operators allows reduction of one of the major sources of systematic errors in lattice studies of hadronic physics. ESA

N93-16422# Rome Univ. (Italy). Dipar di Fisica.
ERGODIC PROPERTIES OF HIGH DIMENSIONAL SYMPLECTIC MAPS
M. Falcioni (Istituto Nazionale di Fisica Nucleare, Rome, Italy), U. Marini Bettolo Marconi (Camerino Univ., Italy), and A. Vulpiani (Aquila Univ., Italy) 17 May 1991 32 p Submitted for publication
(Preprint-802; ETN-93-92911) Avail: CASI HC A03/MF A01

Numerical studies on the long time behavior of a high dimensional system of coupled symplectic maps are reported. They are studied as a function of their number N and of the nearest neighbor coupling strength epsilon. The system, at a fixed value of epsilon, displays regular motion only in a small fraction of the phase space, whose volume vanishes exponentially with N. Regarding the chaotic motions, a scaling behavior of the mean square fluctuation sigma is found. For large systems, a very weak Arnold diffusion and different trajectories, with high value of the Lyapunov exponents, is observed to maintain some of its own features for very long time. The localization properties of the tangent vector are studied. For chaotic trajectories, at small values of epsilon, an initially small perturbation increases through a few directions. This behavior may be seen as a failure of ergodicity and as a confirmation of the relevance of the Nekhoroshev scenario also in high dimensional systems. ESA

N93-16662*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
APPROXIMATION METHODS FOR STOCHASTIC PETRI NETS
Hauke Joerg Jungnitz May 1992 179 p
(Grant NAGw-1333)
(NASA-CR-191851; NAS 1.26:191851; CIRSSE-119) Copyright Avail: CASI HC A09/MF A02

Stochastic Marked Graphs are a concurrent decision free formalism provided with a powerful synchronization mechanism generalizing conventional Fork Join Queueing Networks. In some particular cases the analysis of the throughput can be done analytically. Otherwise the analysis suffers from the classical state explosion problem. Embedded in the divide and conquer paradigm, approximation techniques are introduced for the analysis of stochastic marked graphs and Macroplace/Macrotransition-nets (MPMT-nets), a new subclass introduced herein. MPMT-nets are a subclass of Petri nets that allow limited choice, concurrency and sharing of resources. The modeling power of MPMT is much larger than that of marked graphs, e.g., MPMT-nets can model manufacturing flow lines with unreliable machines and dataflow graphs where choice and synchronization occur. The basic idea leads to the notion of a cut to split the original net system into two subnets. The cuts lead to two aggregated net systems where one of the subnets is reduced to a single transition. A further reduction leads to a basic skeleton. The generalization of the idea leads to multiple cuts, where single cuts can be applied recursively leading to a hierarchical decomposition. Based on the decomposition, a response time approximation technique for the performance analysis is introduced. Also, delay equivalence, which has previously been introduced in the context of marked graphs by Woodside et al., Marie's method and flow equivalent aggregation are applied to the aggregated net systems. The experimental results show that response time approximation converges quickly and shows reasonable accuracy in most cases. The convergence of Marie's method and flow equivalent aggregation are applied to the aggregated net systems. The experimental results show that response time approximation converges quickly and shows reasonable accuracy in most cases. The convergence of Marie's is slower, but the accuracy is generally better. Delay equivalence often fails to converge, while flow equivalent aggregation can lead to potentially bad results if a strong dependence of the mean completion time on the interarrival process exists. Author

N93-16670# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
QUEUEING SYSTEMS ON A CIRCLE
Dirk P. Kroese (Freiburg Univ., Germany) and Volker Schmidt Feb. 1992 34 p
(MEMO-1038; ETN-92-92466) Avail: CASI HC A03/MF A01

Queueing systems on a circle, a subclass of nonstandard queueing models found in telecommunication and computer architecture, are investigated. Consider a ring on which customers arrive according to a Poisson process. Arriving customers drop somewhere on the circle and wait there for a server who travels on the ring. Whenever this server encounters a customer, he stops and serves the customer according to an arbitrary service time distribution. After the service is completed, the server removes the client from the circle and resumes his journey. Of interest are the number and the locations of customers that are waiting for service. These locations are modeled as random counting measures on the circle. Two different types of servers are considered: the polling server and the Brownian (or drunken) server. It is shown that under both server motions the system is stable if the traffic intensity is less than 1. Several earlier results on the configuration of waiting customers are extended by combining results from random measure theory, stochastic integration and renewal theory. ESA

N93-16675*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
A PETRI NET CONTROLLER FOR DISTRIBUTED HIERARCHICAL SYSTEMS Thesis
Joseph E. Peck Dec. 1991 146 p
(Grant NAGw-1333)
(NASA-CR-191862; NAS 1.26:191862; CIRSSE-109) Avail: CASI HC A07/MF A02

The solutions to a wide variety of problems are often best organized as a distributed hierarchical system. These systems can be graphically and mathematically modeled through the use of Petri nets, which can easily represent synchronous, asynchronous, and concurrent operations. This thesis presents a controller implementation based on Petri nets and a design methodology for the interconnection of distributed Petri nets. Two case studies are presented in which the controller operates a physical system, the Center for Intelligent Robotic Systems for Space Exploration Dual Arm Robotic Testbed. Author

N93-16849# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
AN M/G/1 QUEUE WITH DEPENDENCE BETWEEN INTERARRIVAL AND SERVICE TIMES
S. C. Borst, O. J. Boxma, and M. B. Combe Oct. 1991 36 p Submitted for publication Sponsored in part by NFI
(CWI-BS-R9125; ETN-92-92476) Copyright Avail: CASI HC A03/MF A01

A variant of the M/G/1 queue in which the service times of arriving customers depend on the length of the interval between their arrival and the previous arrival is analyzed. Such a dependence structure arises when individual customers arrive according to a Poisson process, while customer collectors are sent out according to a Poisson process to collect the customers and to bring them to the service facility. In this case collected number of customers, and total collected service requests, are correlated with the corresponding collect intervals. Viewing a batch of collected customers as one customer gives rise to an M/G/1 queue with a positive correlation between service times of such customers and their interarrival times. Both for individual customers and for batches of collected customers, the transforms of the sojourn time, waiting time and queue length distributions, are derived. The results are compared with those for the ordinary M/G/1 queue without dependence. ESA

N93-17195# Los Alamos National Lab., NM.
STATISTICAL ERROR IN A CHORD ESTIMATOR OF CORRELATION DIMENSION: THE RULE OF FIVE

J. Theiler and T. Lookman (University of Western Ontario, London.) 1 Sep. 1992 14 p Presented at the 2nd Bifurcations and Chaos Workshop on Dynamical Measures of Complexity and Chaos, Bryn Mawr, PA, 13-15 Aug. 1992
(Contract W-7405-eng-36)
(DE93-000687; LA-UR-92-2972; CONF-9208161-1) Avail: CASI HC A03/MF A01

The statistical precision of a chord method for estimating dimension from a correlation integral is derived. The optimal chord length is determined, and a comparison is made to other estimators. The simple chord estimator is only 25 percent less precise than the optimal estimator which uses the full resolution and full range of the correlation integral. The analytic calculations are based on the hypothesis that all pairwise distances between the points in the embedding space are statistically independent. The adequacy of this approximation is assessed numerically, and a surprising result is observed in which dimension estimators can be anomalously precise for sets with reasonably uniform (nonfractal) distributions. DOE

N93-17196# Sandia National Labs., Albuquerque, NM.
VARIANCE OF TEMPORAL MOMENT ESTIMATES OF A SQUARED TIME HISTORY
D. O. Smallwood 1992 11 p Presented at the 63rd Shock and Vibration Symposium, Las Cruces, NM, 27 Oct. 1992
(Contract DE-AC04-76DP-00789)
(DE93-000753; SAND-92-1201C; CONF-9210176-3) Avail: CASI HC A03/MF A01

An earlier paper described the use of bandlimited temporal moments to characterize shocks and short duration nonstationary vibration. An important aspect of applying this technique is an appreciation of the magnitude of the errors which could be expected when estimating the temporal moments and other properties of the time histories which are functions of the estimated temporal moments. Examples of these other properties are: the centroid, (tau); the rms duration, D; skewness, S; kurtosis, K; and the root energy amplitude, A(sub e). Estimates of the errors are important for choosing analysis parameters, like filter bandwidths, and when reviewing the reduced data. This paper explores the variance of estimates of the temporal moments, and functions of the temporal moments, when computed for data. For a product model, it is shown that the normalized error can be expressed in terms of a BT (bandwidth x time) like product. DOE

N93-17221# Rome Univ. (Italy). Dipt. di Fisica.
THE LAGRANGIAN APPROACH TO STOCHASTIC VARIATIONAL PRINCIPLES ON CURVED MANIFOLDS
Ettore Aldrovandi (SISSA, Trieste, Italy), Daniela Dohrn (Aquila Univ., Italy), and Francesco Guerra 27 Sep. 1991 17 p Sponsored in part by Italian Ministry of University Research and Science and Technology
(Preprint-825; ETN-93-92929) Avail: CASI HC A03/MF A01

The classical definition of the action functional can be extended to the case of diffusion processes. For the stochastic action functional obtained, variational principles proposed by Morato are introduced. In order to generalize the class of process variations, the notion of stochastic differential systems is given. The resulting programming equations are equivalent to the quantum Schroedinger equation satisfying a plasma like equation with a dissipative behavior. The main properties of stochastic variational principles in the Eulerian form are reviewed. The tranformation of the Eulerian frame to a Lagrangian frame is presented. The programming equations coming from the Lagrangian frame are analyzed. ESA

N93-17405# Tilburg Univ. (Netherlands). Dept. of Economics.
VERIFICATION AND VALIDATION OF SIMULATION MODELS
Jack P. C. Kleijnen Mar. 1992 26 p
(FEW-542; ETN-92-92545) Avail: CASI HC A03/MF A01

A survey of techniques used for the verification and validation of models, especially simulation models is given. A novel way of applying basic regression analysis to validate a model is introduced. Verification involves the discovery of programming errors. Validations covered the problem of how to investigate whether the model is a good representation of reality. Models resemble information systems. They are a key element in some types of information systems, namely the Decision Support Systems (DSS). The importance of mathematical statistics in simulation is demonstrated. It is concluded that the developers and users of a simulation model should be convinced of its validity, not only by statistics but also in many other ways, some of which are presented. ESA

N93-17674# Warwick Univ., Coventry (England).
INTERPRETATION OF TIME SERIES FROM NONLINEAR SYSTEMS. VOLUME 58: PROCEEDINGS OF THE IUTAM SYMPOSIUM AND NATO ADVANCED RESEARCH WORKSHOP ON THE INTERPRETATION OF TIME SERIES FROM NONLINEAR MECHANICAL SYSTEMS
P. G. Drazin and G. P. King 1992 518 p Symposium held in England, 26-30 Aug. 1991
(Contract DAJA45-91-M-0135)
(AD-A258028; R/D-6554-MA-02-Vol-58) Avail: CASI HC A22/MF A04

This is a report of the proceedings of the IUTAM Symposium and NATO Advanced Research Workshop on The Interpretation of Time Series from Nonlinear Mechanical Systems, held at the University of Warwick, England, from 26-30 August 1991. It contains a brief and partial review of the state of the art of the subject, and an account of a few highlights of the symposium. This paper also introduces the papers which follow in this volume, papers which report some of the contributions to the symposium. GRA

N93-17764# Naval Postgraduate School, Monterey, CA.
A REVISED LOWER CONFIDENCE LIMIT PROCEDURE FOR THE RELIABILITY OF COMPLEX QUASI-COHERENT SYSTEMS M.S. Thesis
Bambang Poernomo Sep. 1992 123 p
(AD-A257599) Avail: CASI HC A06/MF A02

This thesis describes a procedure for computing a lower confidence limit on the reliability of a quasi-coherent complex system using test data on its components. The failure times of the components are assumed to have either exponential or Weibull distributions with unknown parameters. The accuracy of this procedure is evaluated using computer simulation for various system structures and sets of parameter values for the assumed distributions. This thesis is an extension of a thesis by Kah Chee Yee in that it uses a different equation for the estimate of the shape parameter in the Weibull distribution than Yee used, and it evaluates the procedure for a larger collection of system structures. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N93-15679# General Accounting Office, Washington, DC. National Security and International Affairs Div.
STRATEGIC DEFENSE INITIATIVE: ESTIMATES OF BRILLIANT PEBBLES' EFFECTIVENESS ARE BASED ON MANY UNPROVEN ASSUMPTIONS
Mar. 1992 32 p
(AD-A256810; GAO/NSIAD-92-91) Avail: CASI HC A03/MF A01

In January 1991, the President directed that the Strategic Defense Initiative (SDI) program be refocused toward providing protection against limited ballistics missile strikes, whether deliberate, accidental, or unauthorized. The proposed system concept is known as Global Protection Against Limited Strikes, or GPALS, and would consist of both-surface- and space-based sensors and interceptors. Because this was a significant change in the program, the Strategic Defense Initiative Organization (SDIO) and its contractors are still adapting the SDI program to the directive and are assessing a proposed space-based interceptor system known as Brilliant Pebbles. GRA

N93-16070# General Accounting Office, Washington, DC. Resources Community and Economic Development Div.
STRATEGIC DEFENSE INITIATIVE: 15-YEAR FUNDING REQUIREMENTS
Feb. 1992 30 p
(AD-A256738; GAO/NSIAD-92-92FS) Avail: CASI HC A03/MF A01

In the spring of 1991, the Director of SDIO presented SDIO's estimated funding requirements through fiscal year 2005 during testimony before several congressional subcommittees. At that time, the focus of the SDI program was to create the GPALS system, which was intended to provide worldwide

protection against limited, unauthorized, or accidental ballistic missile attacks. Since that time, congressional direction through the National Defense Authorization Act for fiscal Years 1992 and 1993 has shifted the focus of the SDI program to a smaller Limited Defense System. This fact sheet refers to the SDI program as it was presented during the spring of 1991, before the recent congressional action. All figures used are in fiscal year 1991 dollars. We believe this information will provide a useful starting point for future analyses of the SDI program. It should be noted, however, that SDIO is still adjusting SDI program plans in response to the congressional direction and significant changes can be expected. GRA

N93-16236# Analytical Systems Engineering Corp., Rome, NY.
ENHANCEMENT OF MULTIPLE TARGET TRACK SIMULATION Final Technical Report, May 1989 - Apr. 1990
Jeffrey L. Penatzer Aug. 1992 37 p
(Contract F30602-87-D-0088)
(AD-A257224; RL-TR-92-221) Avail: CASI HC A03/MF A01

The objective is the development of an integrated simulation of Strategic Defense Initiative (SDI) Acquisition, Tracking, Pointing, and Fire Control (ATP-FC) functions from previously developed simulations of a subset of the individual functions which would be required for a complete end-to-end simulation of a space-based Directed Energy Weapon (DEW) platform. The functions integrated were the Target Detection, Multiple Target Tracking (MTT), and Target Sequencing functions. Additionally, the Plume-to-Hardbody Handover function was partially integrated. The task consisted of the following subtasks: (1) Incorporation of previously developed target sequencing algorithms (Nearest Neighbor and Farthest Insertion) into a previously existing MTT simulation; (2) Investigation and incorporation of an improved target detection algorithm to replace the target detection algorithm that was included with the original previously existing MTT simulation; and (3) Incorporation of previously developed Plume-to-Hardbody handover algorithms into the combined MTT and target sequencing simulation. The work performed in accomplishing these three subtasks is summarized. GRA

N93-16611*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
THE MODELING OF PIEZOCERAMIC PATCH INTERACTIONS WITH SHELLS, PLATES AND BEAMS Final Report
H. T. Banks and R. C. Smith Washington Dec. 1992 34 p Submitted for publication
(Contracts NAS1-18605; NAS1-19480; RTOP 505-90-52-01)
(NASA-CR-189740; NAS 1.26:189740; ICASE-92-66) Avail: CASI HC A03/MF A01

General models describing the interactions between a pair of piezoceramic patches and elastic substructures consisting of a cylindrical shell, plate and beam are presented. In each case, the manner in which the patch loads enter both the strong and weak forms of the time-dependent structural equations of motion is described. Through force and moment balancing, these loads are then determined in terms of material properties of the patch and substructure (thickness, elastic properties, Poisson ratios), the geometry of the patch placement, and the voltages into the patches. In the case of the shell, the coupling between banding and inplane deformations, which is due to the curvature, is retained. These models are sufficiently general to allow for potentially different patch voltages which implies that they can be suitably employed when using piezoceramic patches for controlling system dynamics when both extensional and bending vibrations are present. Author

N93-17355# Argonne National Lab., IL. Advanced Computer Application Center.
PARALLELIZING THE TRACK-TARGET MODEL FOR THE MIMD MACHINE
ZhongXiong Wei and Craig Swietlik 1992 4 p Presented at the 1992 Institute of Electrical and Electronic Engineers System, Man and Cybernetics, Chicago, IL, 18-21 Oct. 1992
(Contract W-31-109-eng-38)
(DE92-041100; ANL/CP-76975; CONF-9210177-1) Avail: CASI HC A01/MF A01

Military Tracking-Target systems are important analysis tools for modelling the major functions of a strategic defense system operating against a ballistic missile threat during a simulated end-to-end scenario. As demands grow for modelling more trajectories with increasing numbers of missile types, so have demands for more processing power. Argonne National Laboratory has developed the parallel version of this Tracking-Target model. The parallel version has exhibited speedups of up to a factor of 6.3 resulting from a shared memory multiprocessor machine. This paper documents a project to implement the Tracking-Target model on a parallel processing environment. DOE

N93-17286*# Mississippi State Univ., Mississippi State. Dept. of Industrial Engineering.
REQUIREMENTS FOR THE IMPLEMENTATION OF SCHEDULE REPAIR TECHNOLOGY IN THE EXPERIMENT SCHEDULING PROGRAM
Stanley F. Bullington *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N93-15898# Los Alamos National Lab., NM.
CHAOTIC DYNAMICS IN THE MAXWELL-BLOCH EQUATIONS
D. D. Holm and G. Kovacic Mar. 1992 28 p Presented at the Chaos Down Under, Sydney (Australia), Feb. 1990
(Contract W-7405-eng-36)
(DE93-000854; LA-UR-92-3126; CONF-9002140-2) Avail: CASI HC A03/MF A01

In the slowly varying envelope approximation and the rotating wave approximation for the Maxwell-Bloch equations, we describe how the presence of a small-amplitude probe laser in an excited, two-level, resonant medium leads to homoclinic chaos in the laser-matter dynamics. We also describe a derivation of the Maxwell-Bloch equations from an action principle. DOE

N93-16351# Groningen Rijksuniv. (Netherlands). Dept. of Computing Science.
PROOF ELIMINATION IN TYPE THEORY
Peter J. deBruin 18 Mar. 1992 17 p
(CS-9202; ETN-93-92832) Avail: CASI HC A03/MF A01

Work to develop a type theory into a complete alternative to traditional set theory as a foundation of mathematics is presented. When type theory is to be used as a fully fledged foundation of mathematics, presence of powersets or equivalently impredicative propositions is indispensable. The 'iota' operation of constructing a function from a single valued relation is not representable in present systems. An existential quantifier with a new elimination rule is proposed, and it is shown how iota and quotient types can then be defined. The results lead to the conclusion that, if one wishes to use the logic of type theory as a reduction system, the new principle resists the idea of proof irrelevance. To avoid complications in the proof system, it is suggested to distinguish terms as they occur in the proof system from reducible terms as they may be extracted from proofs. ESA

N93-16415*# Rome Univ. (Italy). Dipartimento di Fisica.
ON LATTICE CHIRAL GAUGE THEORIES
L. Maiani (Istituto Nazionale di Fisica Nucleare, Rome, Italy), G. C. Rossi (Tor Vergata Univ., Rome, Italy), and M. Testa (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 12 Mar. 1991 12 p Sponsored in part by NASA, Washington and Ministry of Education
(Grant NSF PHY-89-04035)
(Preprint-794; ETN-93-92903; NASA-CR-192238; NAS 1.26:192238) Avail: CASI HC A03/MF A01

The Smit-Swift-Aoki formulation of a lattice chiral gauge theory is presented. In this formulation the Wilson and other non invariant terms in the action are made gauge invariant by the coupling with a nonlinear auxilary scalar field, omega. It is shown that omega decouples from the physical states only if appropriate parameters are tuned so as to satisfy a set of BRST identities. In addition, explicit ghost fields are necessary to ensure decoupling. These theories can give rise to the correct continuum limit. Similar considerations apply to schemes with mirror fermions. Simpler

cases with a global chiral symmetry are discussed and it is shown that the theory becomes free at decoupling. Recent numerical simulations agree with those considerations. ESA

N93-16561# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
DIGITAL SIMULATION AND DISCRETE MODELLING OF A CHAOTIC SYSTEM
Steve A. Billings and Luis A. Aguirre Mar. 1992 30 p
(Grant CNPQ-200597/90-6)
(RR-447; ETN-92-92772) Avail: CASI HC A03/MF A01

The influence of the integration interval delta t of the fourth order Runge-Kutta algorithm on Duffing's equation is investigated. Discretized models of the continuous equation are derived. The effects of the discretization period T on the discrete models are studied. Bifurcation diagrams and Poincare maps are used to assess the accuracy of the results. It is shown that both these methods suggest smaller upper bounds for the integration interval and the discretization period than other criteria. The main results were: both delta t and T have strong effects on the dynamical behavior of the considered models; most of the effects are not clearly evident from the simulated time series; and the increase in delta t and T affects the respective model in different ways. ESA

N93-16957# Rome Univ. (Italy). Dipt. di Fisica.
SUPERSYMMETRY IN SPIN GLASS DYNAMICS
J. Kurchan (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 3 Dec. 1991 32 p
(Preprint-843; ETN-93-92945) Avail: CASI HC A03/MF A01

The spin glass phase transition is discussed in terms of supersymmetry breaking. In the superspace notation, the dynamics are expressed in terms of a single superspace function Q, and the dynamic problem bears a striking formal similarity with its static replica treatment counterpart. This similarity can be used to show that the supersymmetric dynamical solution and the replica symmetric solutions yield the same static results for a wide range of models. A Hilbert space construction of the Fokker-Plank problem associated with the dynamics is presented. The symmetries of the action functional are discussed. Taking advantage of the form of the dynamic equations in superspace it is shown that they can be solved in a form that makes close contact with their static replica counterpart. ESA

N93-16968# Rome Univ. (Italy). Dipt. di Fisica.
A DISCRETE NEUMANN SYSTEM
O. Ragnisco (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 3 Mar. 1992 9 p
(Preprint-870; ETN-93-92970) Avail: CASI HC A02/MF A01

An integrable discrete time version of the Neumann system is presented. It obtains from the Toda-lattice a spectral problem by requiring the potential to be restricted to a suitable finite dimensional manifold. The analogy with the continuous Neumann system is explained. Some interesting open problems are outlined. An alternative discrete time version of the Neumann system can be derived in the framework of the 'restricted flows technique': the system is related to the Toda hierarchy exactly in the same way as the Neumann system is related to the Korteweg-de Vries hierarchy. Its Lagrangian turns into the Lagrangian of the Neumann system after a suitable continuum limit. For such a map, complete integrability in the Arnold-Liouville sense is proven. A complete set of independent invariants in involution are presented. Questions concerning Lax representation, bihamiltonian structure, and separability are mentioned. ESA

N93-16976# Rome Univ. (Italy). Dipt. di Fisica.
WEAK MATRIX ELEMENTS
Guido Martinelli (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 10 Jan. 1992 15 p Repr. of Nuclear Physics B (Proc. Suppl.), v. 30, 1992 p 1-20
(Preprint-854; ETN-93-92956) Avail: CASI HC A03/MF A01

Lattice calculations of weak matrix elements are reviewed. The problem of the matching between lattice bare operators and the corresponding renormalized operators in the continuum is discussed. A method to study heavy meson semileptonic decays and the Isgur-Wise function on the lattice is presented. ESA

N93-16992# Rome Univ. (Italy). Dipt. di Fisica.
STOCHASTIC QUANTIZATION, STOCHASTIC CALCULUS AND PATH INTEGRALS: SELECTED TOPICS
L. Bertini, G. Jona-Lasinio, and C. Parrinello (New York Univ., New York.) 6 Nov. 1991 35 p Submitted for publication
(Preprint-837; ETN-93-92940) Avail: CASI HC A03/MF A01

Some aspects of stochastic quantization and stochastic partial differential equations are investigated using systematically stochastic calculus. The stochastic quantization is considered as a special case of the theory of the stochastic partial differential equations. Some definitions and results in the story of stochastic ordinary differential equations are summarized. The basic idea of the non perturbative approach to the stochastic quantization of P(phi)(sub 2) is described. A new form of perturbation theory in terms of iterated Ito integrals is developed. Results of the theory of large deviations are used to obtain, via stochastic quantization, a qualitative understanding of path integral formulae for gauge theories with gauge fixing term. The Zwanziger scheme where non gradient stochastic partial differential equations are involved is discussed. The approach provides alternatives to the Fadeev-Popov path-integral formula and permits an understanding of the gauge fixing problem. The relationship between supersymmetry and stochastic calculus is illustrated. The connection between stochastic quantization and supersymmetry is discussed. ESA

N93-17386# Los Alamos National Lab., NM.
FROM THE ROTATION GROUP TO THE POINCARE GROUP
J. D. Louck 1992 15 p Presented at the 6th Symmetries in Science, Bregenz (Austria), 2-7 Aug. 1992
(Contract W-7405-eng-36)
(DE93-000864; LA-UR-92-3200; CONF-9208164-1) Avail: CASI HC A03/MF A01

Larry Biedenham is, perhaps, best known for his penetrating insights into the relevance of abstract mathematics for the structure of physical theory and his ability to implement this mathematics in a style comprehensible to physicists. This is well-illustrated by his many recent contributions to q-algebras. He has also written numerous papers concerned with the pedagogy of physical theory -- papers with the purpose of clarifying the content and meaning of a subject. It is in the spirit of these latter contributions that the present paper is presented. The subject is the quantum rotation group, SU(2), the group of 2 x 2 unitary unimodular matrices, and its fundamental role in physical theory. The fact that the irreducible representations (irreps) of the group SU(2) can be realized by unitary transformation of state vectors whose domain of definition is the usual Euclidean 3-space, R(sup 3), is usually obscured by the fact that one is accustomed to thinking of the underlying group of transformations on R(sup 3) the group SO(3,R) of proper orthogonal matrices. We show in the first part of this paper how one can formulate the usual 'orbital angular momentum theory' from the viewpoint of SU(2) alone. The motivation for this approach is to eliminate from the language of quantum mechanics the ambiguities arising from the highly unsatisfactory notion of 'double-valued functions'. In the second part of the paper, we show how the irreps of SU(2), extended to GL(2,C), enter into the description of the unitary irreps of the Poincare group. We emphasize again the uniform role of SU(2), in contrast to SO(3,R), and point out the several ways that the standard irreps of SU(2) occur. In the third part of the paper, we discuss the parametrization of SL(2,C) in terms of biquaternions and mention the problem of determining the discrete subgroups of SL(2,C). DOE

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N93-15844# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
OUTPUT FREQUENCY CHANGES IN A COMMERCIAL RUBIDIUM CLOCK RESULTING FROM MAGNETIC FIELD AND MICROWAVE POWER VARIATIONS M.S. Thesis
Edward B. Sarosy Sep. 1992 100 p
(AD-A256466; AFIT/GE/ENG/92S-01) Avail: CASI HC A05/MF A02

This report shows the relationship between output frequency shifts and

the absorption cell magnetic field during microwave power fluctuations on a commercial rubidium frequency clock. Changes in the clock output frequency relative to the 10 MHz reference were monitored as changes in the absorption cell magnetic field (0.01 to 1.0 Gauss) and changes in the cell's interrogation microwave power were varied from the nominal specification (P(sub 0)) at four discrete values (+1.3. -1.1, -2.2, -4.O dB). The maximum normalized output frequency shift of 1.4x10(exp -10) occurred at -4dB. The maximum normalized frequency change for the +1.3 and -1.1 dB data is about 3x10(exp -11), and for the -2.2 dB data is about 6x10(exp -11). As a function of the change in microwave power, the maximum frequency change is about 2.6x10(exp -11) per dB of power change. There also existed several magnetic field values which resulted in minimum output frequency change. This occurred at absorption cell magnetic field values of 9 and 27 milli-Gauss, where the nominal setting is 137 milli-Gauss. GRA

N93-15854# Dalhousie Univ., Halifax (Nova Scotia). Dept. of Physics.
PHYSICS AND CHEMISTRY IN HIGH ELECTRIC FIELDS
H. J. Kreuzer 6 Oct. 1992 14 p
(Contract N00014-80-J-1796)
(AD-A257138; TR-10) Avail: CASI HC A03/MF A01

Progress is reviewed in our understanding of the effects of high electrostatic fields (of the order of volts per angstrom) on the adsorption and reaction of atoms and molecules on metal and semiconductor surfaces. GRA

N93-15945# Superconducting Super Collider Lab., Dallas, TX.
RECENT EFFORTS ON NONLINEAR DYNAMICS
A. Chao Jul. 1992 7 p Presented at the 15th International Conference on High Energy Accelerators, Hamburg, Germany, 20-24 Jul. 1992 Revised
(Contract DE-AC35-89ER-40486)
(DE92-040625; SSCL-Preprint-132-Rev-1; CONF-920706-5-Rev-1) Avail: CASI HC A02/MF A01

This is a brief survey of the recent efforts made during the past few years on the subject of nonlinear dynamics. A list of contributions on this subject, including some on nonlinear spin dynamics, to this conference is given. DOE

N93-15999# Stanford Univ., CA. Dept. of Mechanical Engineering.
CONSERVATION LAWS FOR ELASTIC SYSTEMS WITH DISSIPATION Final Report, 31 May 1991 - 31 Jul. 1992
Tanios Honein and George Herrmann 30 Sep. 1992 10 p
(Contract DAAL03-91-G-0185)
(AD-A257168; ARO-28957.1-MA) Avail: CASI HC A02/MF A01

Research was concerned with applying the Neutral Action method in order to derive conservation laws for viscoelastic bodies. In contrast with previous attempts, emphasis was put in constructing conservation laws in the space-time domain and the viscoelastic models considered are therefore given in terms of rate equations. The final report summarizes the results of this effort. GRA

N93-16200# Superconducting Super Collider Lab., Dallas, TX.
INFLUENCE OF CABLE EDDY CURRENTS ON MAGNETIC FIELD HARMONICS
T. Ogitsu, Y. Zhao, A. Akhmetov, and A. Devred Jul. 1992 6 p Presented at the ICFA Workshop on AC Superconductivity, Tsukuba, Japan, 23-25 Jun. 1992 Revised
(Contract DE-AC35-89ER-40486)
(DE92-040549; SSCL-Preprint-134-Rev-A; CONF-9206281-1-Rev-A) Avail: CASI HC A02/MF A01

Several SSC 5-cm-aperture, 15-m-long dipole magnet prototypes exhibit anomalous behavior of their magnetic field harmonics during current ramps at 4 A/s. The anomalies cease when the ramp is stopped and the current is held constant. The magnets also exhibit a dramatic degradation of their quench current as a function of ramp rate, as well as large AC-losses. After reviewing the AC-performance of the anomalous magnets, we develop a model of cable eddy currents, which can simulate the observed field behavior and the measured AC-losses, and which is consistent with the quench start localization of the high ramp-rate quenches. DOE

N93-16208# Aerodyne Research, Inc., Billerica, MA. Center for Chemical and Environmental Physics.
UHV-COMPATIBLE ELECTROSTATICALLY-DRIVEN TUNING FORK CHOPPER
Paul L. Kebabian, Spiros Kallelis, David D. Nelson, Jr., and Andrew Freedman Sep. 1992 14 p
(Contract N00014-92-C-0196)
(AD-A256943; ARI-RR-944) Avail: CASI HC A03/MF A01

We have developed an electrostatically driven tuning fork chopper which is compatible with an ultrahigh vacuum (UHV) environment. Constructed with a commercially available tuning fork using stainless steel and alumina parts, the chopper is capable of operating while exposed to high temperature samples and corrosive gases. Operation in a UHV environment while modulating both optical and molecular beams is demonstrated. GRA

N93-16418# Rome Univ. (Italy). Dipartimento di Fisica.
BROWNIAN MOTION [MOTO BROWNIANO]
Giovanni Gallavotti 26 Apr. 1991 17 p In ITALIAN
(Preprint-797; ETN-93-92906) Avail: CASI HC A03/MF A01

Theoretical models and equations describing Brownian motion are reviewed. The displacement of about 0.001 cm performed by the components of a colloid, observed by R. Brown in 1828, is due to mechanical causes. The principles of Einstein's theory for the Brownian movement and the Einstein-Smoluchowsky diffusion coefficient are presented. The Smoluchowsky theory based on the molecular chaos model, implicit in the Boltzmann's equation, is summarized. The calculation of the conjugated velocity and position probability distribution, performed by Uhlenbeck and Ornstein, is discussed. The equations of Wiener, which are based on a mathematical abstraction of the Brownian motion, are explained. ESA

N93-16421# Rome Univ. (Italy). Dipartimento di Fisica.
AN INTRODUCTION TO SUPERCONDUCTIVITY
C. DiCastro and R. Raimondi 10 May 1991 60 p
(Preprint-801; ETN-93-92910) Avail: CASI HC A04/MF A01

Experimental and theoretical data concerning superconductivity are summarized. Experimental aspects of ordinary superconductors which are important to the discussion of the basic concepts of the theory are reviewed and some phenomenological interpretation of these experimental facts are given. The two requirements which any theory of superconductivity must satisfy are the Landau criterion and the order parameter. The discussion of the criterion of condensation enable the concept of the order parameter to be introduced. The symmetry of a system, represented by the group of transformations which leave invariant the Hamiltonian, is discussed. The concept of paraconductivity, the Hartree-Fock approximation and the theory of Bardeen Cooper and Schrieffer, are summarized. ESA

N93-16555*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ELECTROMAGNETIC POTENTIAL VECTORS AND THE LAGRANGIAN OF A CHARGED PARTICLE
John V. Shebalin Washington Nov. 1992 17 p Submitted for publication
(RTOP 505-90-52-01)
(NASA-TM-107703; NAS 1.15:107703; ICASE-IR-24) Avail: CASI HC A03/MF A01

Maxwell's equations can be shown to imply the existence of two independent three-dimensional potential vectors. A comparison between the potential vectors and the electric and magnetic field vectors, using a spatial Fourier transformation, reveals six independent potential components but only four independent electromagnetic field components for each mode. Although the electromagnetic fields determined by Maxwell's equations give a complete description of all possible classical electromagnetic phenomena, potential vectors contains more information and allow for a description of such quantum mechanical phenomena as the Aharonov-Bohm effect. A new result is that a charged particle Lagrangian written in terms of potential vectors automatically contains a 'spontaneous symmetry breaking' potential. Author

N93-16573# Universiteit Twente, Enschede (Netherlands).
PROPERTIES OF THE SUPERCONDUCTOR IN ACCELERATOR DIPOLE MAGNETS Ph.D. Thesis

Derk terAvest 1991 247 p Sponsored in part by Netherlands Technology Foundation
(ISBN-90-9004244-X; ETN-92-92825) Avail: CASI HC A11/MF A03

Several aspects of the application of superconductors to high field dipole magnets for particle accelerators are discussed. The attention is focused on the 10 tesla (1 m model) magnet that is envisaged for the future Large Hadron Collider (LHC) accelerator. The basic motivation behind the study is the intention of employing superconductors to their utmost performance. An overview of practical supercomputers, their applications and their impact on high field dipole magnets used for particle accelerators, is presented. The LHC reference design for the dipole magnets is outlined. Several models were used to study the influence of a number of factors in the shape and in particular, the deviation from the shape that is due to the flux flow state. For the investigated extrinsic and intrinsic factors, a classification can be made with respect to the effect on the shape of the characteristic of a multifilamentary wire. The optimization of the coil structure for high field dipole magnets, with respect to the field quality is described. An analytical model for solid and hollow filaments, to calculate the effect of filament magnetization in the quality of the dipole field, is presented. ESA

N93-17034# Maryland Univ., College Park. Dept. of Electrical Engineering.
MATHEMATICAL MODELS OF HYSTERESIS
I. D. Mayergoyz Sep. 1992 7 p
(Contract DE-FG05-88ER-13846)
(DE93-001837; DOE/ER-13846/5) Avail: CASI HC A02/MF A01

This report discusses the mathematical models of the hysteresis of magnetic materials and superconducting materials. DOE

N93-17217# Rome Univ. (Italy). Dipt. di Fisica.
PHASE DIAGRAM BY FRUSTRATED VORTICES IN POTTS MODELS
A. M. Allega (Salerno Univ., Italy) 27 Jan. 1992 20 p
(ROM1F-92-860; ETN-93-92962) Avail: CASI HC A03/MF A01

A detailed Monte Carlo analysis of a low temperature phase diagram is carried out. The three spatial dimensional three state Potts model with mixed ferromagnetic and antiferromagnetic spin couplings is considered. An approach to the Potts models by vortex lines is presented. It is shown that at low temperatures the numerical algorithm traces a variety of vortex lines in the whole lattice volume and not only in the superantiferromagnetic phase 2. By listing all the combinatoric possibilities of spin cell configurations, the vortex content of every phase is reported. The whole phase diagram structure is analyzed in terms of observables exclusively measured in the ensemble of vortices. ESA

N93-17530# Maryland Univ., College Park.
MATHEMATICAL MODELS OF HYSTERESIS
I. D. Mayergoyz 1991 19 p
(Contract DE-FG05-88ER-13846)
(DE93-001836; DOE/ER-13846/4) Avail: CASI HC A03/MF A01

The research described in this proposal is currently being supported by the US Department of Energy under the contract 'Mathematical Models of Hysteresis'. Thus, before discussing the proposed research in detail, it is worthwhile to describe and summarize the main results achieved in the course of our work under the above contract. Our ongoing research has largely been focused on the development of mathematical models of hysteretic nonlinearities with 'nonlocal memories'. The distinct feature of these nonlinearities is that their current states depend on past histories of input variations. It turns out that memories of hysteretic nonlinearities are quite selective. Indeed, experiments show that only some past input extrema leave their marks upon future states of hysteretic nonlinearities. Thus, special mathematical tools are needed in order to describe nonlocal selective memories of hysteretic nonlinearities. Our research has been primarily concerned with Preisach-type models of hysteresis. All these models have a common generic feature: they are constructed as superpositions of simplest hysteretic nonlinearities-rectangular loops. Our study has by and large been centered around the following topics: various generalizations and extensions of the classical Preisach model; finding of necessary and sufficient conditions for the representation of actual hysteretic nonlinearities by various Preisach type models; solution of identification problems for these models; numerical implementation; and experimental testing of Preisach type models. Although the study of Preisach type models has constituted the main direction of the research, some effort has also been made to establish some interesting connections between these models and such topics as: the critical state model for superconducting hysteresis; the classical Stoner-Wohlfarth model of vector magnetic hysteresis; thermal activation type models for viscosity; magnetostrictive hysteresis; and neural networks. DOE

N93-17531# Texas Univ., Austin.
COMPLEX TEMPORAL AND SPATIAL PATTERNS IN NONEQUILIBRIUM PROCESSES
H. L. Swinney 1992 12 p
(Contract DE-FG05-88ER-13821)
(DE93-001845; DOE/ER-13821/6) Avail: CASI HC A03/MF A01

We have used dynamical systems methods to study and characterize bifurcations and pattern formation in a variety of nonequilibrium systems. In this paper, we describe our work on dynamical systems, chemical oscillations and chaos, chemical spatial patterns, instabilities in fluid dynamics, electrodeposition clusters, the ballast resistor, and crack propagation. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation.
For noise pollution see *45 Environmental Pollution.*

N93-15890# Washington State Univ., Pullman. Dept. of Physics.
SCATTERING AND RADIATION BY SHELLS AND NONLINEAR ACOUSTICS OF PARTICLE SUSPENSIONS Final Report, 15 Jul. 1989 - 30 Sep. 1992
Philip L. Marston 23 Oct. 1992 69 p
(Contract N00014-89-J-3800)
(AD-A257257) Avail: CASI HC A04/MF A01

The research reported concerns three main areas: (1) Surface Guided Wave Contributions to the Scattering of Sound by Elastic Shells in Water - Quantitative ray representations described for the scattering by shells give insight into the coupling of sound with structures. Backscattering enhancement near the coincidence frequency was observed, modeled, shown to be due to a subsonic wave. Aspects of a high-frequency enhancement were investigated along with time-frequency spectrograms of the impulse response; (2) Radiation Mechanisms for Evanescent Tone Bursts on Fluid Loaded Membranes and Plates - Subsonic flexural waves on unbounded plates ordinarily produce evanescent wavefields in the surrounding fluid that are trapped to the plate. Two mechanisms for radiating sound were investigated experimentally: diffraction by a rigid barrier in an evanescent field in air, and transition radiation produced when a wave packet travels down a vertical plate through a water surface; (3) Acoustical Four-Wave Mixing in Suspensions - Sound is shown to interact with sound in a suspension of microspheres. The spheres are attracted to pressure nodes of counter-propagating pump waves. The banded suspension acts as a diffraction grating and scatters a probe-wave when a Bragg condition is satisfied. GRA

N93-15936# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth Atmospheric and Planetary Sciences.
APPLICATION OF RAY-BORN SCATTERING AND BOUNDARY PERTURBATION METHODS TO ACOUSTIC REVERBERATION Final Technical Report, 15 Jun. 1989 - 30 Sep. 1991
M. N. Toksoz Aug. 1992 34 p
(Contract N00014-89-J-3011)
(AD-A255712) Avail: CASI HC A03/MF A01

This study utilizes ultrasonic water tank modeling to examine three-dimensional scattering trends from a random set of parallel grooves, and compares this with theoretical results obtained from two-dimensional finite-difference calculations. Ultrasonic laboratory modeling is carried out using computer-controlled source and receivers with an aluminum block submerged in a water tank. The block's upper interface is plane for the reference model and grooved for the test model. The grooves measure about one-third the center source wavelength and have a Gaussian distribution with a mean of 1 wavelength and a standard deviation of 1/3 wavelength. This experiment places both the source and receiver at the water's surface with the receiver array in the horizontal plane. The receiver line is then positioned at various angles to grooves. A staggered-grid

finite-difference scheme is used for theoretical computations and comparisons with laboratory data. These theoretical results matched experimental data well for both the plane interface and the grooved model. Specifically, this study shows that scattering mechanisms are different for propagation normal to grooves than those parallel to the grooves. In the first case scattering takes place in the form of point diffractors. This causes reduction of the specular reflections. Amplitudes decrease by more than 60 percent, relative to a plane interface, when the incidence angle exceeds 45 degrees. 'Snapshots' of finite-difference synthetics helped to clarify details of scattering. In the second case, where the wave front is parallel to the grooves, scattering takes a form of guided head waves and continuous diffractions giving rise to constructive and destructive interference. This gives the illusion of 'broken' reflectors at depth. GRA

N93-16061# Naval Undersea Warfare Center, New London, CT.
A COMPARISON OF ACOUSTIC IMPEDANCE MEASUREMENT TECHNIQUES Progress Report
Andrew J. Hull 1 Sep. 1992 24 p
(DA Proj. RJ1-4-R-13)
(AD-A255566; NUWC-NL-TR-10; Rept-131) Avail: CASI HC A03/MF A01

This report describes an investigation that compares two acoustic impedance measurement techniques. The first is a wave decomposition method that breaks the wave energy into reflected and incident components and then calculates acoustic impedance. The second is an inverse eigenvalue method that inverts the functional form of impedance tube eigenvalues and then calculates acoustic impedance. An experiment comparing the measured acoustic impedance from both methods results in similar values. GRA

N93-16121# Naval Academy, Annapolis, MD.
DETERMINATION OF TURBULENT VELOCITIES BY NONLINEAR ACOUSTIC SCATTERING Final Report, 1991 - 1992
James E. Parker, III 8 May 1992 151 p
(AD-A257114; USNA-TSPR-193) Avail: CASI HC A08/MF A02

The scattering of sound by the nonlinear interaction of two sound beams in the presence of turbulence is used to experimentally measure the turbulent velocities generated by a submerged water jet. When two sound beams of primary frequencies f01 and f02 intersect in a region of turbulent flow, the nonlinear scattering generates sum and difference frequency components (f0+ = f01 + f02 and f0- = f01 - f02) which radiate outside the interaction region. In the absence of turbulence, the crossed beams do not produce radiated sum and difference frequencies. In this experiment, two transducers emit continuous wave focused sound beams of frequencies f01 = 2.0 MHz and f02 = 2.1 MHz, respectively. A receiving transducer, located outside the interaction region, detects the scattered sum frequency (f0 = 4.1 MHz). Scattering results measured at 80 degree angles for each of 11 scan positions across the jet are used to map out the velocity correlation coefficients of the turbulence. Results are then compared with earlier published experiments that use conventional hotwire probes to measure a similar turbulent jet flow in air. GRA

N93-16460 Department of the Navy, Washington, DC.
METHOD OF ACOUSTIC PROCESSING FOR ACOUSTIC IMAGE CLASSIFICATION Patent
James G. Kelly, inventor (to Navy) and Robert N. Carpenter, inventor (to Navy) 5 May 1992 6 p Filed 28 Oct. 1991
(AD-D015454; US-Patent-5,111,438; US-Patent-Appl-SN-783665; US-Patent-Class-367-87) Avail: US Patent and Trademark Office

A method of acoustic processing for acoustic image classification of an underwater target from a set of known target hypotheses is provided. An acoustic waveform is transmitted into a test volume of water containing the target to be classified. The test volume is divided into test cells such that each test cell contains a portion of the target or scatterer that will scatter the transmitted waveform. Scattering of the transmitted waveform at each test cell is described by a scattering coefficient that is unique for each of the targets in the set of known hypotheses. Accordingly, the scattering coefficient serves as an identifier of the target to be classified. The relationship of the set of scattering coefficients for each of the known target hypotheses is provided by a known covariance matrix. An acoustic receive array receives a portion of the scattered waveform from each of the test cells in the test volume. This received portion is a function of the scattering coefficients of the target to be classified and the transmitted waveform appropriately time delayed by the time between transmission and receipt. The scattering coefficients at each test cell are then estimated for each of the possible hypotheses. Estimation is based upon the known covariance matrices and the receive portion of the scattering. Then, an estimation is made of the received portion of the scattering for each of the possible hypotheses. Estimation of this receive portion is based upon the estimated scattering coefficients and the time-delayed, transmitted waveform. Finally, the estimated received portion of the scattering is correlated with the actual received portion of the scattering. A high correlation is indicative of the target to be classified. GRA

N93-16676*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
AN ANALYSIS OF TEMPERATURE-INDUCED ERRORS FOR AN ULTRASOUND DISTANCE MEASURING SYSTEM M. S. Thesis
David Paul Wenger Dec. 1991 43 p
(Grant NAGw-1333)
(NASA-CR-191859; NAS 1.26:191859; CIRSSE-106) Avail: CASI HC A03/MF A01

The presentation of research is provided in the following five chapters. Chapter 2 presents the necessary background information and definitions for general work with ultrasound and acoustics. It also discusses the basis for errors in the slant range measurements. Chapter 3 presents a method of problem solution and an analysis of the sensitivity of the equations to slant range measurement errors. It also presents various methods by which the error in the slant range measurements can be reduced to improve overall measurement accuracy. Chapter 4 provides a description of a type of experiment used to test the analytical solution and provides a discussion of its results. Chapter 5 discusses the setup of a prototype coilision avoidance system, discusses its accuracy, and demonstrates various methods of improving the accuracy along with the improvements' ramifications. Finally, Chapter 6 provides a summary of the work and a discussion of conclusions drawn from it. Additionally, suggestions for further research are made to improve upon what has been presented here. Author

N93-16755*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECT OF SONIC BOOM ASYMMETRY ON SUBJECTIVE LOUDNESS
Jack D. Leatherwood and Brenda M. Sullivan (Lockheed Engineering and Sciences Co., Hampton, VA.) Dec. 1992 32 p
(RTOP 537-03-21-03)
(NASA-TM-107708; NAS 1.15:107708) Avail: CASI HC A03/MF A01

The NASA Langley Research Center's sonic boom apparatus was used in an experimental study to quantify subjective loudness response to a wide range of asymmetrical N-wave sonic boom signatures. Results were used to assess the relative performance of several metrics as loudness estimators for asymmetrical signatures and to quantify in detail the effects on subjective loudness of varying both the degree and direction of signature loudness asymmetry. Findings of the study indicated that Perceived Level (Steven's Mark 7) and A-weighted sound exposure level were the best metrics for quantifying asymmetrical boom loudness. Asymmetrical signatures were generally rated as being less loud than symmetrical signatures of equivalent Perceived Level. The magnitude of the loudness reductions increased as the degree of boom asymmetry increased, and depended upon the direction of asymmetry. These loudness reductions were not accounted for by any of the metrics. Corrections were determined for use in adjusting calculated Perceived Level values to account for these reductions. It was also demonstrated that the subjects generally incorporated the loudness components of the complete signatures when making their subjective judgments. Author

N93-17051*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CONSECUTIVE PLATE ACOUSTIC SUPPRESSOR APPARATUS AND METHODS Patent Application
Joseph Doychak, inventor (to NASA) and Tony Parrott, inventor (to NASA) 16 Oct. 1992 20 p
(NASA-Case-LEW-15430-1; NAS 1.71:LEW-15430-1; US-Patent-Appl-SN-961943) Avail: CASI HC A03/MF A01

An apparatus and method for suppressing acoustic noise utilizes consecutive plates, closely spaced to each other so as to exploit dissipation

associated with sound propagation in narrow channels to optimize the acoustic resistance at a liner surface. The closely spaced plates can be utilized as high temperature structural materials for jet engines by constructing the plates from composite materials. Geometries of the plates, such as plate depth, shape, thickness, inter-plate spacing, arrangement, etc., can be selected to achieve bulk material-like behavior. NASA

N93-15750# Alenia Spazio S.p.A., Rome (Italy).
ACOUSTIC TESTS STRUCTURAL PREDICTIONS
C. Bruno and L. Scolamiero *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 725-729 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-15782# Borello (G.), Sainte Jean-l'Union (France).
EFFECT OF THE PAYLOAD ON THE SURROUNDING INTERNAL ACOUSTIC ENVIRONMENT AT LIFT-OFF
G. Borello *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 945-948 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A01/MF A04

N93-15786# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
THE USE OF REVERBERANT-ROOM ACOUSTIC TESTING FOR SPACECRAFT STRUCTURES AND THEIR PAYLOADS
D. C. G. Eaton, G. Boulked, and G. Paindessous *In its* Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 969-977 (For primary document see N93-15718 05-18)
Copyright Avail: CASI HC A02/MF A04

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N93-15659# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
MULTI-ION AMBIPOLAR DIFFUSION Ph.D. Thesis
Thomas E. Gist Jul. 1992 333 p
(AD-A256568; AFIT/DS/ENP/92-1) Avail: CASI HC A15/MF A03

The continuity and momentum equations for electrons and multiple ion species are solved analytically and numerically using a new model for ambipolar diffusion. The general form of the model is valid for any quasi-neutral plasma for which the diffusion approximation is appropriate, including positive or negative ions, arbitrary geometries, and time dependence. The model provides criteria for determining when single ion diffusion theory is appropriate for describing multi-ion discharges, when a multi-ion proportional model is appropriate, and when a multi-ion nonproportional model is necessary. An expression is developed which provides a necessary condition for proportionality and provides the proportionality constant from the net source terms. Proportional analytic solutions are determined for uniform external ionization or single-step ionization by the bulk electrons in planar and cylindrical geometries, and double-exponential external ionization or bulk ionization and nonresonant charge transfer in planar geometries. Numerical comparisons are made to previous experimental and theoretical determinations of electron temperature, particle flux, or particle number densities. Numerical solutions for generic two-ion plasmas with recombination or charge transfer as volume losses and external or electron impact ionization sources provide scaling relationships for the effects of multiple ions on discharge parameters. GRA

N93-15885# Washington Univ., Seattle. Dept. of Chemistry.
ATOMIC PROBES OF SURFACE STRUCTURE AND DYNAMICS
E. J. Heller and H. Jonsson 1992 9 p
(Contract DE-FG06-91ER-14224)
(DE92-040066; DOE/ER-14224/1) Avail: CASI HC A02/MF A01

Semiclassical methods that will allow much faster and more accurate three-dimensional atom/surface scattering calculations, both elastic and inelastic, are being developed. The scattering of He atoms from buckyballs is being investigated as a test problem. Somewhat more detail is given on studies of He atom scattering from defective Pt surfaces. Molecular dynamics simulations of He(+) and Ar(+) ion sputtering of Pt surfaces are also being done. He atom scattering from Xe overlayers on metal surfaces and the thermalized dissociation of H2 on Cu(110) are being studied. DOE

N93-15959# California Univ., Berkeley. Lawrence Berkeley Lab.
TILTED CRANKING CLASSIFICATION OF MULTIBAND SPECTRA
S. Frauendorf and F. R. May (Niels Bohr Inst., Copenhagen, Denmark) 19 Jun. 1992 10 p Presented at the International Conference on Nuclear Structure at High Angular Momentum, Ottawa, Ontario, 18-21 May 1992
(Contract DE-AC03-76SF-00098)
(DE92-041187; LBL-32497; CONF-9205108-15) Avail: CASI HC A02/MF A01

The existence of TDHF-solutions rotating uniformly about a nonprincipal axis of the deformed axial potential is demonstrated. The solutions represent Delta(I) = 1 bands. Self consistency and symmetry are discussed. The transformation of experimental spectra to the rotating frame of reference is introduced. Excitation spectra at high spin are calculated and found to agree well with recent data on Er-163 and Hf-174. DOE

N93-15976# Superconducting Super Collider Lab., Dallas, TX.
THE CABIBBO-KOBAYASHI-MASKAWA MIXING MATRIX
F. J. Gilman, K. Kleinknecht, and B. Renk (Mainz Univ., Germany) Apr. 1992 12 p
(Contract DE-AC35-89ER-40486)
(DE93-001255; SSCL-Preprint-597) Avail: CASI HC A03/MF A01

In the standard model with SU(2) x U(1) as the gauge group of electroweak interactions, both the quarks and leptons are assigned to be left-handed doublets and right-handed singlets. The quark mass eigenstates are not the same as the weak eigenstates, and the matrix relating these bases was defined for six quarks and given an explicit parameterization by Kobayashi and Maskawa in 1973. It generalizes the four-quark case, where the matrix is parameterized by a single angle, the Cabibbo angle. This report discusses this matrix. DOE

N93-16011# Los Alamos National Lab., NM.
DYNAMICAL APPROACH TO PAIR PRODUCTION FROM STRONG FIELDS
F. Cooper 1992 47 p Presented at the NATO Advanced Study Institute on Particle Production in Highly Excited Matter, Ciocco, Italy, 12-25 Jul. 1992
(Contract W-7405-eng-36)
(DE92-040224; LA-UR-92-2753; CONF-920777-1) Avail: CASI HC A03/MF A01

In relativistic heavy-ion collisions one is hoping to produce conditions where energy densities are high enough so that a new state of matter-the quark-gluon plasma can be produced. This state of matter lasts for a short period of time following the collision and may or may not be in equilibrium. Following this phase a transition to ordinary hadronic matter takes place and many of the processes which occur during the quark-gluon plasma phase might be masked by processes which occur in the hadronic phase. In order to determine processes which might be signals of the quark gluon plasma one needs to know the dynamical evolution of the plasma. This is because the particles that get produced during that phase have to travel through a time evolving plasma. In order to study this problem one needs a different way of thinking about field theory. Traditionally experiments in elementary particle physics are black box experiments where initial particles enter a region, final particles exit the experimental region and all that is asked is how many particles of what type, energy, etc. enter various detectors. This type of experiment requires only a covariant S-Matrix theory to predict the probabilities to be expected in the detectors. However, if we want to know signatures of the quark gluon plasma, we actually need to follow the time evolution of the plasma and fields produced following the heavy ion collision. This requires a non-covariant real time formalism for the time evolution of the quantum fields. The various formalisms are presented for doing real time calculations in quantum field theory and then apply one of them to a very simplified model of the production of the quark-gluon plasma-Schwinger's mechanism for pair production from strong 'classical' gauge fields. DOE

N93-16038# Case Western Reserve Univ., Cleveland, OH. Dept. of Macromolecular Science.
THEORETICAL DEVELOPMENT FOR DEPTH PROFILING OF STRATIFIED LAYERS USING VARIABLE ANGLE ATR
Robert A. Shick, Jack L. Koenig, and Hatsuo Ishida 11 Sep. 1992 37 p
(Contract N00014-92-J-1590)
(AD-A255571; CWRU/DMS/TR-46) Avail: CASI HC A03/MF A01

The theory allowing depth profile information to be recovered from variable angle attenuated total reflection spectroscopy is shown for both perpendicular and parallel polarizations. The errors invoked by the necessary approximations are evaluated by comparison with exact optical simulations using dispersion theory. GRA

N93-16074# Naval Academy, Annapolis, MD.
APPLICATIONS OF MOLECULAR MODELING TO TRANSITION STATE ENERGIES AND CONFORMATIONS Final Report, 1991 - 1992
John C. Mohs 8 May 1992 79 p
(AD-A257130; USNA-TSPR-192) Avail: CASI HC A05/MF A01

A quantitative model of Baldwin's Rules for Ring Closure is constructed. Specific system of interest are the lactonization and intramolecular Michael addition. A simulated transition state for each of these reactions is determined for simplified intermolecular systems. The intermolecular system for lactonization is the attack of water on pronate formic acid. The intermolecular system for the Michael addition is the attack of water on protonated acrylic acid. These transition state geometries are determined at the AMI semi-empirical level. Results of these geometries are combined with force constant determined in this research to produce a molecular mechanics model for these transition states. Reactivity determinations made using this model for competitive lactonizations and intramolecular Michael additions are acceptable. A strain energy cutoff range for Baldwin Rule 5-Endo-Trig has been determined to be between 63.9 and 80.4 kcal/mol. GRA

N93-16146# Louisiana State Univ., Baton Rouge.
RESEARCH IN ELEMENTARY PARTICLE PHYSICS
Lai-Him Chan, R. Haymaker, R. Imlay, R. McNeil, W. Metcalf, and R. Svoboda 1992 115 p
(Contract DE-FG05-91ER-40617)
(DE93-001858; DOE/ER-40617/134) Avail: CASI HC A06/MF A02

We describe theoretical work on effective action expansion on an effective low energy theory of hadrons and lattice gauge theories. The high energy experimental group at Louisiana State University has analyzed data on a neutrino oscillation experiment at LAMPF. The LSND neutrino experiment is preparing to take data in 1993. IMB data has been analyzed. Preparations for a beam test at KEK for IMB are in progress. Dumand is preparing to test one string of the detector early next summer. The ZEUS electron proton colliding beam experiment has started to take data. Early results have been reported. DOE

N93-16147# Cincinnati Univ., OH.
RESEARCH IN PARTICLE THEORY
F. Mansouri, P. Suranyi, and L. C. R. Wijewardhana Oct. 1992 15 p
(Contract DE-FG02-84ER-40153)
(DE93-002868; DOE/ER-40153/9) Avail: CASI HC A03/MF A01

Dynamics of 2+1 dimensional gravity is analyzed by coupling matter to Chern Simons Witten action in two ways and obtaining the exact gravity Hamiltonian for each case. 't Hoot's Hamiltonian is obtained as an approximation. The notion of space-time emerges in the very end as a broken phase of the gauge theory. We have studied the patterns of discrete and continuous symmetry breaking in 2+1 dimensional field theories. We formulate our analysis in terms of effective composite scalar field theories. Point-like sources in the Chern-Simons theory of gravity in 2+1 dimensions are described by their Poincare' charges. We have obtained exact solutions of the constraints of Chern-Simons theory with an arbitrary number of isolated point sources in relative motion. We then showed how the space-time metric is constructed. A reorganized perturbation expansion with a propagator of soft infrared behavior has been used to study the critical behavior of the mass gap. The condition of relativistic covariance fixes the form of the soft propagator. Approximants to the correlation critical exponent were obtained in two loop order for the two and three dimensional theories. We proposed a new model of QED exhibiting two phases and a Majorana mass spectrum of single particle states. The model has a new source of coupling constant renormalization which opposes screening and suggests the model may confine. Assuming that the bound states of e(sup +)e(sup (minus)) essentially obey a Majorana spectrum, we obtained a consistent fit of the GSI peaks as well as predicting new peaks and their spin assignments. DOE

N93-16160# Temple Univ., Philadelphia, PA. Dept. of Physics.
EXPERIMENTAL INVESTIGATIONS IN PARTICLE PHYSICS AT INTERMEDIATE ENERGIES
L. B. Auerbach, V. L. Highland, K. W. McFarlane, and S. H. Kettell 12 Jul. 1992 32 p
(Contract DE-FG02-88ER-40389)
(DE93-000406; DOE/ER-40389/75) Avail: CASI HC A03/MF A01

The major emphasis of this project continues to be on fundamental symmetries and parameters of the Standard Model. A test of a quark model prediction was also done. The projects in the current period have been the following: LSND, a neutrino oscillation experiment at LAMPF; E791, a search for the decays K(sub L)(sup 0) yields (mu)e and K(sub L)(sup 0) yields ee; E871, tests and preparations for an upgrade proposal; and E888, a search for the H dibaryon. The LSND (Large Scintillator Neutrino Detector) is under construction at this time. Progress in the construction schedule has been accelerated with the expectation of being ready to accept beam in March 1993. The automated system for testing photomultiplier tubes is in full production, and should be able to certify a fun complement of tubes for installation by October 1992. Results of an earlier LAMPF experiment, E764, on the interaction of muon neutrinos with carbon nuclei have been submitted for publication. A thorough 'blind' analysis of the E791 data set has just been brought to completion. Final results for the upper limits (90 pct. C.L.) on the branching ratios for the decays K(sub L)(sup 0) yields (mu)e and K(sub L)(sup 0) yields ee are 3.3 x 10(sup -11) and 4.1 x 10(sup -11), respectively. The final result for the branching ratio for K(sub L)(sup 0) yields (mu)(mu) from all the data (720 events) is (7.0 + or - 0.4 + or - 0.2) x 10(sup -9). The potential of the E791 detector for rare K decays has reached its limit. Before disassembly it was used to mount a search (E888) for a possible long-lived six-quark state, the H. At the same time studies have been made of an upgraded version of the experiment (E871) that will make use of a portion of the existing apparatus. DOE

N93-16161# California Univ., San Diego.
STUDIES IN THEORETICAL PARTICLE PHYSICS
D. B. Kaplan 1 Aug. 1992 11 p
(Contract DE-FG03-90ER-40546)
(DE93-000648; DOE/ER-40546/T1) Avail: CASI HC A03/MF A01

This report focuses on research on three distinct areas of particle physics: Chiral Fermions on the Lattice; Weak Scale Baryogenesis; analysis of parity violating nuclear forces, and other an attempt to render the electric dipole moment of the neutron immune from quantum gravity corrections. DOE

N93-16182# Los Alamos National Lab., NM.
TRANSIENT RADIATION EFFECTS IN POLARIZATION-MAINTAINING FIBERS
L. D. Looney and P. B. Lyons 1992 9 p Presented at the International Society for Optical Engineering Meeting, Boston, MA, 8-11 Sep. 1992
(Contract W-7405-eng-36)
(DE92-040355; LA-UR-92-2886; CONF-9209184-2) Avail: CASI HC A02/MF A01

Polarization-maintaining fibers were irradiated with 1.5 ns electron pulses. Linearly polarized light was injected into the fiber, aligned either parallel or perpendicular to the fiber core's stress axis. Linearly polarized light was detected with a high speed optical system, with the polarization axis either parallel or perpendicular to the stress axis. Light throughput and attenuation were documented in these four geometries. No differences were observed in radiation-induced attenuation between the two injection conditions when the output observations were aligned with input orientation. No evidence in this time regime was seen for radiation-induced mode crossover, i.e., no signal (to less than 1 percent of the power transmitted along the injection axis) was observed in the cross polarization state at the output as a consequence of the irradiation. DOE

N93-16184# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Chemistry.
NUCLEAR RESEARCH WITH HEAVY IONS
M. Kaplan Aug. 1992 82 p
(Contract DE-FG02-87ER-40324)
(DE92-040840; DOE/ER-40324/6) Avail: CASI HC A05/MF A01

This report discusses the following topics: studies of light-charged-particle emission from fission and ER reactions in the system 344-MeV Si-28 + Sb-121 yields Tb-149; the role of reversed kinematics and double kinematic solutions in nuclear reactions studies; improvements in interactive data analysis and graphical representations; studies of the reaction 856-MeV Mo-98 + V-51 yields Tb-149 (E* = 224-MeV): emission of intermediate-mass fragments; particle-particle correlations in compound nucleus reactions: preliminary consideration of lifetime estimates from small angle data; light particle emission studies using a new scintillator array; statistical evaporation calculations: developments with the computer codes LILITA-N90 and CASCADE; STAR star collaboration studies: simulations for the conceptual design of the STAR detector system at RHIC; asymmetric fission of Tb*-149 from the finite-range, rotating-liquid-drop model: mean total kinetic energies for binary fragmentation; and charged-particle evaporation from hot composite nuclei: evidence over a broad z range for distortions from cold nuclear profiles. DOE

N93-16198# Oak Ridge National Lab., TN.
A SIMPLE POSITIVE/NEGATIVE SURFACE IONIZATION SOURCE
G. D. Alton, G. D. Mills, and M. T. Johnson (Hamline Univ., Saint Paul, MN.) 1992 22 p Presented at the 6th International Conference on Electrostatic Accelerators and Associated Boosters, Padua, Italy, 1-4 Jun. 1992
(Contract DE-AC05-84OR-21400)
(DE93-000974; CONF-920656-4) Avail: CASI HC A03/MF A01

A versatile, spherical-geometry, self-extraction surface ionization source has been designed, fabricated, and characterized. The source utilizes direct-surface ionization to form either positive or negative ion beams resulting from interactions between highly electropositive or electronegative atoms or molecules and a spherical-sector surface ionizer maintained at approximately 1100 C. For positive ion generation, the surface ionizer is chosen to be a high-work-function metal such as Mo, Ta, or W; while for negative ion formation, a LaB6 surface ionizer is selected. The design features and performance of the source for each of these modes of operation are discussed. DOE

N93-16217# Oak Ridge National Lab., TN.
ANALYSIS OF LOW ENERGY ELECTRON EMISSION ARISING DURING SLOW MULTICHARGED ION-SURFACE INTERACTIONS
P. A. ZeijlmansvanEmmichoven, I. G. Hughes, C. C. Havener, D. M. Zehner, and F. W. Meyer 1992 5 p Presented at the 6th International Conference on Physics of Highly Charged Ions, Manhattan, KS, 28 Sep. - 2 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-000970; CONF-920948-1) Avail: CASI HC A01/MF A01

We have undertaken a search for low energy electrons expected to arise in low energy multicharged ion-surface interactions when electrons captured into Rydberg levels of the projectile are promoted to the continuum as the projectile impacts the surface. Measurements are presented for 30-100 keV N(2+) -- N(6+) ions incident at 20 degrees with the surface on Cu(001) and Au(011) single crystals, for a series of observation angles. DOE

N93-16239# Clark Univ., Worcester, MA.
NUCLEAR STRUCTURE RESEARCH
D. S. Brenner Jul. 1992 11 p
(Contracts DE-FG02-88ER-40417; DE-AC02-76CH-00016)
(DE93-000405; DOE/ER-40417/9) Avail: CASI HC A03/MF A01

The TRISTAN on-line isotope separator and the capture gamma ray facility at the HFBR are the experimental foci of the program which has four principal research themes, three involving nuclear structure physics and one directed towards astrophysics. These themes are: (1) the manifestation of the proton-neutron interaction in the evolution of nuclear structure and its relation to collectivity; (2) the appearance and the role of symmetries and supersymmetries in nuclei; (3) the study of new regions of magic nuclei; and (4) the characterization of nuclei important in r-process stellar nucleosynthesis. DOE

N93-16268# Argonne National Lab., IL.
THE IMPORTANCE OF HINDERED ROTATIONS AND OTHER ANHARMONIC EFFECTS IN THE THERMAL DISSOCIATION OF SMALL UNSATURATED MOLECULES: APPLICATION TO HCN
A. F. Wagner, J. H. Kiefer (Illinois Univ., Chicago.), and S. S. Kumaran (Illinois Univ., Chicago.) 1992 20 p Presented at the 24th International Symposium on Combustion, Sydney, Australia, 5-10 Jul. 1992
(Contracts W-31-109-eng-38; DE-FG02-85ER-13384)
(DE92-040734; ANL/CP-76916; CONF-920707-31) Avail: CASI HC A03/MF A01

A standard low-pressure limit RRKM rate constant is shown to significantly underestimate measured thermal dissociation rates for C2H2 and HCN if the correct value of the bond dissociation energy is used. An explanation for this discrepancy is sought by examining anharmonic effects, especially those involving large angle bends that lead to isomerization. For HCN, an approximate, adiabatic quantum mechanical calculation of the complete spectrum of all bound states up to the dissociation energy is performed. The spectrum is dominated at the dissociation energy by a partially hindered 2D rotation, even though the isomerization barrier on the potential energy surface exceeds 40 kcal/mole. This occurs in part because adiabatic influences from the two stretching frequencies reduce the effective isomerization barrier and increase the effective mass of the rotation. The anharmonic effects from this hindered rotation and its coupling with the anharmonic H stretch modify the rate constant so as to largely remove the discrepancy with experiment. It is argued that the same effects are present in the dissociation of other small unsaturated molecules such as C2H2. DOE

N93-16276# Oak Ridge National Lab., TN.
THE BINARY COLLISION APPROXIMATION: BACKGROUND AND INTRODUCTION
M. T. Robinson Aug. 1992 35 p Presented at the Conference on Computer Simulations of Radiation Effects in Solids, Berlin, Germany, 23-28 Aug. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040887; CONF-9208146-1) Avail: CASI HC A03/MF A01

The binary collision approximation (BCA) has long been used in computer simulations of the interactions of energetic atoms with solid targets, as well as being the basis of most analytical theory in this area. While mainly a high energy approximation, the BCA retains qualitative significance at low energies and, with proper formulation, gives useful quantitative information as well. Moreover, computer simulations based on the BCA can achieve good statistics in many situations where those based on full classical dynamical models require the most advanced computer hardware or are even impracticable. The foundations of the BCA in classical scattering are reviewed, including methods of evaluating the scattering integrals, interaction potentials, and electron excitation effects. The explicit evaluation of time at significant points on particle trajectories is discussed, as are scheduling algorithms for ordering the collisions in a developing cascade. An approximate treatment of nearly simultaneous collisions is outlined and the searching algorithms used in MARLOWE are presented. DOE

N93-16303# Los Alamos National Lab., NM.
THE EXPERIMENTAL STATUS OF NEUTRINO MASSES AND MIXINGS
R. G. H. Robertson 1992 17 p Presented at the Physics Beyond the Standard Model 3 Conference, Ottawa, Ontario, 22-24 Jun. 1992
(Contract W-7405-eng-36)
(DE93-000862; LA-UR-92-3208; CONF-9206251-2) Avail: CASI HC A03/MF A01

We review the current status of experimental knowledge about neutrinos derived from kinematic mass measurements, neutrino oscillation searches at reactors and accelerators, solar neutrinos, atmospheric neutrinos, and single and double beta decay. The solar neutrino results yield fairly strong and consistent indications that neutrino oscillations are occurring. Other evidence for new physics is less consistent and convincing. DOE

N93-16304# Los Alamos National Lab., NM.
APPLICATION OF MULTISTEP COMPOUND AND MULTISTEP DIRECT MODELS FOR DATA EVALUATION
M. B. Chadwick and P. G. Young 1992 11 p Presented at the Symposium on Nuclear Data Evaluation Methodology, Upton, NY, 12-16 Oct. 1992

(Contract W-7405-eng-36)
(DE93-000865; LA-UR-92-3199; CONF-921046-1) Avail: CASI HC A03/MF A01

We have implemented the quantum mechanical multistep compound (MSC) and multistep direct (MSD) theories of Feshbach, Kerman, and Koonin (FKK) for the calculation of nucleon-induced multistep reactions. Our code system, FKK-GNASH, uses the FKK theory for primary preequilibrium emission and describes subsequent equilibrium emission using the Hauser-Feshbach code GNASH. The MSC contribution yields emitted particles with angular distributions symmetric about ninety degrees, whereas the MSD contribution, calculated by averaging DWBA cross sections for particle-hole excitations in the continuum, results in forward-peaked preequilibrium emission. The original picture of the evolution of the reaction, as described by FKK, is modified to allow transitions from the MSD to MSC chain. This modification is consistent with semiclassical preequilibrium descriptions, and allows a good description of preequilibrium spectra and angular distributions for a range of different reactions. As an example of our methodology, we calculate (sup 93)Nb(n,n') reactions at 14, 20 and 26 MeV, and (sup 93)Nb(n,p) at 14 MeV, comparing our results with experimental data. Use of the FKK theory has the advantage that preequilibrium calculations are based on rigorous physical principles, and (unlike semiclassical approaches) allow a good description of angular distributions. We argue that our implementation of the FKK theory maximizes the level of predictability, which is needed for data evaluations. DOE

N93-16305# Los Alamos National Lab., NM.
ON THE 17-keV CONUNDRUM
A. Hime 1992 8 p Presented at the 15th International Conference on Neutrino Physics, Granada, Spain, 7-13 Jun. 1992
(Contract W-7405-eng-36)
(DE93-000866; LA-UR-92-3194; CONF-9206227-2) Avail: CASI HC A02/MF A01

Recent developments in pursuance of the 17-keV neutrino are discussed with emphasis upon experiments employing solid state detectors. Studies have shown that electron scattering effects are the likely origin of the anomalies observed in beta decay spectra measured at Oxford and Guelph. While missing links remain, it is improbable that a 17-keV neutrino exists in nature and a resolution of this conundrum is within reach. DOE

N93-16306# Los Alamos National Lab., NM.
NEUTRINO MASS AND MIXING, AND NON-ACCELERATOR EXPERIMENTS
R. G. H. Robertson 1992 18 p Presented at the 26th International Conference on High Energy Physics, Dallas, TX, 6-12 Aug. 1992
(Contract W-7405-eng-36)
(DE93-000867; LA-UR-92-3192; CONF-920837-6) Avail: CASI HC A03/MF A01

We review the current status of experimental knowledge about neutrinos derived from kinematic mass measurements, neutrino oscillation searches at reactors and accelerators, solar neutrinos, atmospheric neutrinos, and single and double beta decay. The solar neutrino results yield fairly strong and consistent indication that neutrino oscillations are occurring. Other evidence for new physics is less consistent and convincing. DOE

N93-16341# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
BRST FIELD THEORY OF RELATIVISTIC PARTICLES
J. W. vanHolten 5 Feb. 1992 17 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie
(NIKHEF-H/92-04; ETN-93-92814) Avail: CASI HC A03/MF A01

A generalization of BRST field theory based on wave operators for the fields constructed out of, but different from the BRST operator, is presented. Their quantization, gauge fixing, and the derivation of propagators are discussed. The generalized theories are shown to be relevant to relativistic particle theories in the Brink-Di Vecchia-Howe-Polyakov (BDHP) formulation and an argument that the same phenomenon holds in strong theories is given. In particular, the naive BRST formulation of the BDHP theory is shown to lead to trivial quantum field theories with vanishing correlation functions. ESA

N93-16348# Rome Univ. (Italy). Dipartimento di Fisica.
A STUDY OF IMPROVEMENT IN LATTICE QCD
G. Martinelli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), C. T. Sachrajda (Southampton Univ., England), and A. Vladikas (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 13 Nov. 1990 20 p Submitted for publication Sponsored by Ministry of University and Scientific and Technological Research and Science Research Council
(Contract SCI-0082)
(SSCL-Preprint-766; SHEP-90/91-3; ETN-93-92888) Avail: CASI HC A03/MF A01

A numerical simulation in quenched lattice Quantum Chromodynamics (QCD) using an improved action for the quarks is performed. With this action, the systematic errors in hadronic matrix elements due to the finiteness of the lattice spacing are reduced from terms of O(a) to ones of O(g(sub 0)(exp 2) a), where a and g(sub 0) are the lattice spacing and bare coupling constant respectively. It is demonstrated that for matrix elements of the vector current this corresponds to a reduction of these errors from about 20 to 30 percent to about 5 percent. It is proposed that future simulations in lattice QCD be performed using an improved fermion action. ESA

N93-16361# Rhode Island Univ., Kingston.
SURFACE PHYSICS WITH COLD AND THERMAL NEUTRON REFLECTOMETRY
A. Steyerl Nov. 1991 8 p
(Contract DE-FG02-91ER-45445)
(DE93-001986; DOE/ER-45445/4) Avail: CASI HC A02/MF A01

Three aspects of the research project were stressed during the present first year: (1) Setup of the reflectometer facility at the research reactor of the Rhode Island Nuclear Science Center. The installation provides a narrow 'pencil beam' analyzed by time of flight using a chopper system. Following beam characterization and a test measurement of the total cross section of copper single crystal first reflectivity measurements are currently performed using a supermirror. (2) Design study for the ultracold neutron imaging system, with involvement of the relevant industry. Bids are available for several components indicating that it will be very difficult to build the entire system unless further funds become available. (3) Analysis of features of neutron reflection from surfaces with special emphasis on the effect of surface roughness both on the specular beam and the diffusely reflected and refracted intensity. Previous theoretical studies were supplemented by further numerical calculations of diffuse scattering distributions using different models. Application of ultracold and cold neutron reflectometry to the study of liquid-vapor phase transition were discussed. The theoretical work also includes the development of tentative ideas for novel fundamental physics experiments. DOE

N93-16385# Rome Univ. (Italy). Dipartimento di Fisica.
THEORY OF THE ELECTROWEAK INTERACTIONS
Luciano Maiani (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 2 Jan. 1991 70 p Presented at Cargese Summer School, Italy, 13-25 Aug. 1990
(SSCL-Preprint-775; ETN-93-92889) Avail: CASI HC A04/MF A01

The Z boson physics is reviewed. Special attention is given to the pattern of higher order electroweak corrections to the Z boson physical properties and to the line shape, the comparison of theory with LEP (Large Electron Positron) and collider data, and the resulting limits to the t quark mass. The consequences of the m(sub t) limits for the weak mixing and charge conjugation and space inversion violation parameters of K and B mesons are discussed. The theoretical bounds to the Higgs boson and the t quark masses are studied, in particular those arising from the alleged triviality of nonasymptotically free theories, and the recent numerical, nonpermutative results, derived from lattice simulations. ESA

N93-16394# Rome Univ. (Italy). Dipartimento di Fisica.
LATTICE CALCULATIONS OF f(D) AND f(B)
Luciano Maiani (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 13 May 1991 19 p Sponsored in part by Ministry of University and Scientific and Technological Research
(SSCL-Preprint-798; ETN-93-92907) Avail: CASI HC A03/MF A01

The status of lattice calculations of the axial coupling of D and B mesons is reviewed. There are no clear cut quark model estimates and no experimental determinations which make lattice predictions interesting. The lattice prediction of f(sub D) is established. The value of f(sub B) is still the object of considerable discussion. The results obtained by extrapolation

are consistent with the static limit and point to a large value of f(sub B), if it is accepted that sizeable violations of the scaling law are present at the charm scale. ESA

N93-16397# Royal Holloway and Bedford New Coll., Egham (England). Dept. of Chemistry.
AB INITIO MOLECULAR ORBITAL CALCULATIONS FOR MAGNESIUM-CONTAINING SYSTEMS Final Report, 1 Jun. 1991 - 31 May 1992
P. J. Gardner and D. Steele Aug. 1992 15 p
(Grant AF-AFOSR-0553-89)
(AD-A255811; EOARD-TR-92-09) Avail: CASI HC A03/MF A01

Ab initio molecular orbital calculations for selected magnesium-containing systems have been performed with extended basis sets to examine the convergence of the electrical dipole moment and the total electronic energy. GRA

N93-16407# Oak Ridge National Lab., TN.
ATOMIC COLLISION PHYSICS: A SUMMARY AND SOME PROJECTIONS
S. Datz 1992 12 p Presented at the Nobel Symposium on Heavy Ion Spectroscopy and QED Effects in Atomic Systems, Saltsjoebaden, Sweden, 29 Jun. - 3 Jul. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040638; CONF-9206275-1) Avail: CASI HC A03/MF A01

It seems that it is my task to represent the 'Collision Physics Community' at this symposium. First, we consider the part of atomic collision physics covered at this conference, i.e., multiple electron transfer to highly charged ions, and second we consider some applications of atomic collision experiments to tests of QED. DOE

N93-16414# Rome Univ. (Italy). Dipartimento di Fisica.
MIXING AND CP-VIOLATION IN K AND B-MESONS: A LATTICE QCD POINT OF VIEW
Maurizio Lusignoli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), Luciano Maiani (Istituto Nazionale di Fisica Nucleare, Rome, Italy), Guido Martinelli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and Laura Reina (SISSA, Trieste, Italy) 6 Mar. 1991 36 p
(Preprint-792; ETN-93-92901) Avail: CASI HC A03/MF A01

The neutral K/antineutral K and the neutral B/antineutral B mixing is analyzed on the basis of recent experimental results and theoretical lattice determination of matrix elements. A top mass larger than 130 GeV is found. The value of f(sub B) equal to or greater than 200 MeV, as suggested by lattice calculations, implies a charge conjugation and space inversion violating asymmetry in B decays to J/psi + K(sub s) decays that are much larger than previously estimated. The corresponding theoretical prediction for epsilon(prime)/epsilon is reported. The basic definitions and formulae for the calculations of epsilon, x(sub d) and epsilon(prime) are given. The determination of the real angles from semileptonic data are discussed. The calculation of the relevant Wilson coefficient is illustrated and short distance Quantum Chromodynamics (QCD) corrections are evaluated. The B parameters, which can be derived from lattice calculations, are presented. Asumptions for the B parameters and the numerical analysis are illustrated. ESA

N93-16419# Rome Univ. (Italy). Dipartimento di Fisica.
D DECAYS, B-PHYSICS, AND CP-VIOLATION FROM LATTICE QCD
Guido Martinelli (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 9 May 1991 17 p
(Preprint-799; ETN-93-92908) Avail: CASI HC A03/MF A01

Some recent lattice results concerning semileptonic D decays and B physics are presented. The lattice calculation of the pseudoscalar meson decay constant, together with a large value for the top quark mass, m(sub top) equal to or greater than 130 GeV, implies large charge conjugation and space inversion (CP) violation asymmetry in B decays to K(sub s)J/psi. The essential features of the lattice technique are reviewed. The results for the pseudoscalar meson decay constants and the kaon B parameter are reported. The lattice predictions for semileptonic decays, the experimental data, and other theorical approaches, are presented. The lattice calculation of the B meson decay constant and the implications of lattice results for CP violation are discussed. An outlook on future improvements and new calculations which can be done with numerical methods and are of interest in the physics of the Standard Model are included. ESA

N93-16424# Rome Univ. (Italy). Dipartimento di Fisica.
MIXING OF VECTOR AND AXIAL CORRELATORS AT FINITE VOLUME: IMPLICATIONS FOR LATTICE COMPUTATIONS
V. L. Eletsky (Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow, USSR) and M. I. Polikarpov (Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow, USSR) 23 May 1991 7 p
(Preprint-804; ETN-93-92913) Avail: CASI HC A02/MF A01

Correlators of vector and axial isovector currents are considered in a finite box of large size L, Lm(sub pi) greater than 1. Pion induced finite size effects in this case are shown to result in mixing of the two correlators. It is demonstrated that this may reduce the mass of a(sub 1) meson obtained in lattice simulations as compared to the true one. The mixing discussed may, at high temperature, result in degeneracy of screening masses. Other possible effects of this mixing are discussed. ESA

N93-16443# Rome Univ. (Italy). Dipartimento di Fisica.
FOUR-FERMION OPERATORS WITH IMPROVED NEAREST-NEIGHBOUR ACTION
R. Frezzotti (Tor Vergata Univ., Rome, Italy), E. Gabrielli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), C. Pittori (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and G. C. Rossi (Tor Vergata Univ., Rome, Italy) 4 Jun. 1991 19 p Sponsored in part by Ministry of University and Scientific and Technological Research
(Preprint-805; ETN-93-92914) Avail: CASI HC A03/MF A01

The improvement of local four fermion operators are discussed. The one loop perturbative calculation of their renormalization constants and mixing coefficients in the theory, defined by a nearest neighbor improved lattice action, is presented. This calculation is a necessary ingredient for improved Monte Carlo computations of hadronic matrix elements relevant for weak interactions. It is shown that on-shell lattice matrix elements of local four fermion operators do not contain terms which are of the order of the lattice spacing. The nearest neighbor action and the 'improved' operators are obtained by a variable change in the fermionic function integral. The results are applied to the delta S = 2 case. ESA

N93-16444# Rome Univ. (Italy). Dipartimento di Fisica.
B(SUB c) PRODUCTION
M. Lusignoli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), M. Masetti (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and S. Petrarca (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 5 Jun. 1991 14 p
(Preprint-806; ETN-93-92915) Avail: CASI HC A03/MF A01

The Monte Carlo estimates of the B(sub c) production cross sections, at different high energy accelerators, are presented. The attention is focussed on mesons formed by a bottom antiquark and a charmed quark. In all the considered cases, the estimated fraction F(sub B(sub C)) varies between 0.0001 and 0.002, according to the values assumed for several parameters governing the hadronization phase in the HERWIG Monte Carlo code. The HERWIG Monte Carlo code contains simutators of quantum chromodynamics parton shower, including interference and azimuthal correlations. These parameters should be tuned to actual data for the predictions to become sharper. ESA

N93-16600# Oak Ridge National Lab., TN.
LOW-SPIN IDENTICAL BANDS IN ODD-A NUCLEI
C. Baktash, J. D. Garrett, D. F. Winchell, and A. Smith 1992 7 p Presented at the International Conference on Nuclear Structure At High Angular Momentum, Ottawa, Ontario, 18-21 May 1992
(Contract DE-AC05-84OR-21400)
(DE92-041016; CONF-9205108-2) Avail: CASI HC A02/MF A01

A comprehensive study of odd-A rotational bands in normally-deformed rare-earth nuclei indicates that a large number of seniority-one configurations (30 pct. for odd-Z nuclei) at low spin have moments of inertia nearly identical to that of the seniority-zero configuration of the neighboring even-even nucleus with one less nucleon. It is difficult to reconcile these results with conventional models, based on the traditional picture of nuclear pair correlation in vogue for more than three decades, which predict variations of about 15 pct. in the moments of inertia of configurations differing by one unit in seniority. DOE

N93-16603# Oak Ridge National Lab., TN.
ABOVE-SURFACE NEUTRALIZATION OF HIGHLY CHARGED IONS: THE FORMATION OF HOLLOW ATOMS
J. Burgdoerfer (Tennessee Univ., Knoxville.) and F. Meyer 1992 22 p Presented at the Nobel Symposium on Heavy Ion Spectroscopy and QED Effects in Atomic Systems, Saltsjoebaden, Sweden, 29 Jun. - 3 Jul. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001371; CONF-9206275-2) Avail: CASI HC A03/MF A01

We investigate the interaction of multiply charged ions with metallic surfaces. Simulations are presented displaying the formation of hollow atoms when slow highly charged ions approach the surface. It is shown that above surface neutralization proceeds via hollow-atom formation. Relaxation of the multiply excited states to the ground state occurs only subsequent to the close encounter with the topmost atomic layer. Recent experimental data on K Auger emission and image acceleration confirm this scenario. DOE

N93-16919# Sandia National Labs., Livermore, CA.
A THEORETICAL STUDY OF THE THERMOCHEMISTRY OF MOLECULES IN THE Si-C-Cl-H SYSTEM
M. D. Allendorf and C. F. Melius Oct. 1992 64 p
(Contract DE-AC04-76DR-00789)
(DE93-002598; SAND-92-8623) Avail: CASI HC A04/MF A01

Ab initio electronic structure calculations coupled with empirical corrections are used to obtain a self-consistent set of heats of formation for molecules in the series CH(n)SiCl(m) (n, m = 0-3) and for selected molecules in the series (CH3)(n)SiH(m)Cl(P). Heats of formation are also reported for the series Cl(n)SiSiCl(m) (m,n = 0-3) and for HC=CSiCl2H and H2C=CH(SiCl2H). Gibbs free energies as a function of temperature and standard entropies are given for all molecules in the study. Heats of formation are used to evaluate potential pathways for the decomposition of Cl3SiCH3, a common silicon carbide chemical vapor deposition precursor. The analysis includes the calculation of the transition state for the 1,2-elimination of HCl from Cl3SiCH3. DOE

N93-16945*# Old Dominion Univ., Norfolk, VA. Dept. of Mathematical Sciences.
THEORETICAL STUDIES OF A MOLECULAR BEAM GENERATOR
Progress Report, 16 May - 15 Nov. 1992
John H. Heinbockel Jan. 1993 52 p
(Grant NAG1-1424)
(NASA-CR-191716; NAS 1.26:191716) Avail: CASI HC A04/MF A01

The following is a proposed baseline model that is being developed for the simulation of hydrodynamic generator, which can be converted at a later date to magnetohydrodynamic MHD thruster by adding the necessary electric and magnetic fields. The following development will include the electric and magnetic terms, however, the initial computer program will not include these terms. The analysis that follows is a one species, single temperature model constructed over a domain that is defined by an enclosed region. Author

N93-16954# Rome Univ. (Italy). Dipt. di Fisica.
QCD CORRECTIONS TO Z PAIR HADRONIC PRODUCTION
Barbara Mele (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 20 Oct. 1991 17 p Presented at Istituto Nazionale di Fisica Nucleare Eloisatron Project 17th Workshop on QCD at 200 TeV, Erice, Italy, 11-17 Jun. 1991
(Preprint-832; ETN-93-92935) Avail: CASI HC A03/MF A01

The results obtained for the first order Quantum Chromo-Dynamics (QCD) corrections to the Z pair production cross section at hadron colliders are presented. The calculations included both real and virtual gluon corrections. The method provides a way to test perturbative QCD predictions. The four charged leptons invariant mass distribution relative to the Higgs case for m(sub H) = 600 GeV and m(sub H) = 800 GeV is compared with the ZZ continuum production at large hadron colliders. The strategy adopted to calculate the cross section is summarized. Approximated formula for the total partonic cross section is given. The total cross section for pp decay to ZZ + X is obtained by convoluting parton cross sections with proton structure functions. The results of the cross section for Z pair production versus energy is plotted. The results show that most of the uncertainty of the cross section comes from the structure function dependence. ESA

N93-16959# Rome Univ. (Italy). Dipt. di Fisica.
THE DECAY PI NEUTRAL TO GAMMA NU NU-BAR AS A PROBE OF THE TAU NEUTRINO MAGNETIC MOMENT
D. Grasso (Istituto Nazionale di Fisica Nucleare, Rome, Italy) and M. Lusignoli (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 12 Dec. 1991 13 p
(Preprint-847; ETN-93-92949) Avail: CASI HC A03/MF A01

Assuming a novanishing neutrino magnetic moment the decay rate for pi neutral to gamma-nu-nu(bar) is calculated. The experimental study of this process allows an improvement of the upper limit of the tau neutrino magnetic moment, if sensitivity to a branching ratio B approximately equal to 10 to the minus 11th power is reached. The analysis shows that the branching ratio is much larger than the standard model prediction for a given limit value of mu(nu(sub tau)). ESA

N93-16964# Rome Univ. (Italy). Dipt. di Fisica.
IMPROVED RENORMALIZATION CONSTANTS FOR B DECAY AND BB-BAR MIXING
A. Borrelli (European Organization for Nuclear Research, Geneva, Switzerland) and C. Pittori (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 11 Feb. 1992 27 p Sponsored by Fondazione Angelo della Riccia
(Preprint-864; ETN-93-92966) Avail: CASI HC A03/MF A01

The improvement of lattice matrix elements involving heavy quarks are discussed. The new one loop matching between continuum and improved lattice operators relevant for the evaluation of B meson decay constant and BB-bar mixing amplitude is performed. The method of improvement is presented. The 1/m sub b expansion and the effective field theory are reviewed. The improvement applied to matrix elements involving heavy quarks is presented. It is shown that one shell matrix elements of improved two fermion heavy light operators at one loop do not have order 'a' corrections. Results for two and four fermion heavy light operators, technical details and analytical formulas are given. ESA

N93-16966# Rome Univ. (Italy). Dipt. di Fisica.
GLOBAL CONTINUOUS SYMMETRY AND THE 17keV NEUTRINO
D. Grasso (Pavia Univ., Italy), M. Lusignoli (Pavia Univ., Italy), and M. Roncadelli (Pavia Univ., Italy) 27 Feb. 1992 9 p
(Preprint-868; ETN-93-92968) Avail: CASI HC A02/MF A01

The effects of a very small explicit breaking of a continuous global symmetry advocated in successful models for the 17 keV neutrino are discussed. It is shown that these effects are substantial, even if the explicit breaking terms are suppressed by powers of a scale as large as the Planck mass. The purpose of the analysis is to discuss what happens if the exact U(1)(sub e - mu + tau) global symmetry is explicit broken by a very tiny amount, as a low energy effect of new physics at a scale lambda much larger than the Fermi scale. It is shown that the breaking terms generally induce important neutrino oscillation effects and masses for the flavons that could forbid neutrino decay: only for lambda close to the Planck mass these effects are still compatible with present experimental and cosmological bounds. ESA

N93-16972# Holifield National Lab., Oak Ridge, TN. Inst. for Heavy Ion Research.
ROTATIONAL BAND STRUCTURE OF INTRUDER CONFIGURATIONS: SUCCESS AND LIMITATIONS OF THE CRANKED SHELL MODEL
R. Wyss 1991 20 p Presented at the International Symposium on Reflections and Directions in Low Energy Heavy Ion Physics, Oak Ridge, TN, 14-15 Oct. 1991
(Contracts DE-AC05-84OR-21400; DE-FG05-87ER-40361)
(DE93-001713; CONF-9110289-5) Avail: CASI HC A03/MF A01

Rotational bands built on intruder configurations are discussed within the Cranked Shell Model. The experimental observed alignment pattern occurring in these bands cannot be accounted for by standard mean field calculations. The discrepancy between theory and experiment is traced back to the fact that the neutron-proton interaction is only partly and indirectly included in the standard mean field approach. DOE

N93-16977# Rome Univ. (Italy). Dipt. di Fisica.
CP VIOLATION IN B(SUB C) DECAYS
Marco Masetti (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 5 Mar. 1992 11 p
(Preprint-871; ETN-93-92971) Avail: CASI HC A03/MF A01

The branching ratios and charge conjugation and space conversion (CP) violating partial decay rate asymmetries are calculated for three classes of B sub C decays. A relativistic constituent quark model for form factors and in vacuum insertion approximation are used. The best decay modes in order to observe CP violating asymmetries would be B(+)(sub C) and B(-)(sub C) decays to (C - C(bar)) D(+) and D(-). Large asymmetries are possible also for decays in D*(sub S)D(sup 0) with D(sup 0) decaying in a CP eigenstate, but branching ratios would be very small in this case. Decays in D(rho) and D(pi) are difficult to estimate due to the dominant annihilation contribution and the CP violating asymmetries are small. ESA

N93-16978# Rome Univ. (Italy). Dipt. di Fisica.
LOW ENERGY EFFECTS OF HEAVY CHIRAL FERMIONS
Ferruccio Feruglio (Padua Univ., Italy), Antonio Masiero (Padua Univ., Italy), and Luciano Maiani (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 9 Mar. 1992 47 p
(Preprint-872; ETN-93-92972) Avail: CASI HC A03/MF A01

The low energy effective Lagrangian produced by a heavy chiral fermion, in the limit when M tends to infinity, is studied. In the case of a heavy t-quark, the effective interaction of vector fields, in the anomalous and non anomalous sectors, and the couplings of the Higgs boson are analyzed. Unitary limits to the t quark mass are considered. By considering an additional U(1) component of the electroweak group, an anomalous coupling to the known fermions is not excluded. The tree level effective Lagrangian is considered. The regularization of a chiral gauge theory and the corresponding structure of counterterms are discussed. The terms in delta L, which are not related to the anomaly, are derived. Wess-Zumino and other anomaly related issues are summarized. The couplings of the physical Higgs boson are presented. The unitary bounds are illustrated for the gauge and b quark sectors in SU(2) by U(1), and for the U(1) prime case. ESA

N93-16980# Rome Univ. (Italy). Dipt. di Fisica.
SOLITONS ON DOMAIN WALLS
R. V. Konoplich (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 20 Mar. 1992 16 p
(Preprint-876; ETN-93-92976) Avail: CASI HC A03/MF A01

The model involving two real scalar fields is considered. Analytical solutions for the field configuration corresponding to a domain wall with a soliton living on the wall are found. One loop quantum corrections are calculated to the energy of this field configuration. The purpose of the study is to show that, in the simple model involving two real scalar fields phi and sigma with a weak coupling between scalar fields, it is possible to find the exact soliton solution living on the domain wall and to calculate the quantum mass of this topological structure. Small quantum fluctuations around the soliton background are studied. In a semiclassical approximation, the surface energy density of the static soliton configuration is calculated. ESA

N93-16981# Rome Univ. (Italy). Dipt. di Fisica.
INSTABILITY OF THE INVISIBLE AXION
S. Ghigna (Milan Univ., Italy), M. Lusignoli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and M. Roncadelli (Pavia Univ., Italy) 25 Mar. 1992 7 p
(Preprint-877; FNT/T-92/12; ETN-93-92977) Avail: CASI HC A02/MF A01

Small expicit violations of the Peccei-Quinn symmetry, such as could be expected as remnants of physics at the Planck scale, are shown to have dramatic effects for invisible axion models. The original Dine, Fischer, and Sredmicki model is reviewed. It is shown that the explicit U(1)(sub PQ) symmetry breaking at large scale lambda gives rise to additional violating terms in the low energy lagrangian. The axion mass is shown to be affected by the explicit breakdown of U(1)(sub PQ) symmetry. Because of the U(1)(sub PQ) instability under small explicit violations, the low energy effects of an explicit U(1)(sub PQ) breakdown at lambda cannot be described by an effective field theory. The results hold for hadronic invisible axion and for singlet majoron models. ESA

N93-17014# Rome Univ. (Italy). Dipt. di Fisica.
A LATTICE STUDY OF ELECTROMAGNETIC DECAYS OF VECTOR MESONS
M. Crisafulli (Istituto Nazionale di Fisica Nucleare, Rome, Italy) and V. Lubicz (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 28 Oct. 1991 20 p Sponsored by Istituto Nazionale di Fisica Nucleare
(Preprint-835; ETN-93-92938) Avail: CASI HC A03/MF A01

A lattice study of electromagnetic decays of vector mesons V into pseudoscalar mesons P, relevant to radiative decays V to P-gamma and conversion decays V to P-lepton(+)-lepton(-) is presented. The form factor f(sub q)(q(exp 2)), associated with the electromagnetic current of the quark q, was computed using Wilson fermions in the quenched approximation. The computations were performed by averaging the results over 15 gauge configurations, generated by the Metropolis algorithm, at beta = 6.0, on a 20 by 100 by 40 lattice. By extrapolating linearly the form factor q(exp 2) = 0, f(sub u)(0) = (2.2 +/- 0.3)/GeV was obtained for a massless quark and f(sub s)(0) = (1.8 +/- 0.2)/GeV for a strange quark, in agreement with the experimental values, f(sub u)(0) = (2.32 +/- 0.08)/GeV and f(sub s)(0) = (1.84 +/- 0.06)/GeV. A larger value of f(sub u)(0) is obtained from the vector meson dominance model. The partial widths for the conversion decays were estimated using both a linear dependence on q(exp 2) of the form factor and the vector meson dominance predictions. ESA

N93-17016# Rome Univ. (Italy). Dipt. di Fisica.
TWO-BODY NONLEPTONIC DECAYS OF D MESONS
F. Buccella (Naples Univ., Italy), M. Lusignoli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), G. Miele (Naples Univ., Italy), and A. Pugliese (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 24 Jan. 1992 22 p
(Preprint-859; ETN-93-92961) Avail: CASI HC A03/MF A01

The amplitudes for two body Cabibbo allowed nonleptonic decays of D mesons are evaluated. The factorization approximation from the effective hamiltonian including short distance corrections to next to leading order are considered. Annihilation and W exchange contributions as well as final state interaction effects are crucial to obtain agreement with the experimental data. The decay amplitudes in the factorized approximation are given. The matrix elements of currents for c decay and annihilation terms are discussed. The model used to introduce final state interaction effects is described. The results and conclusions are presented. A discussion of decays to VV final states is given. ESA

N93-17017# Rome Univ. (Italy). Dipt. di Fisica.
COLLECTIVE EXCITATIONS PHOTOEMISSION SPECTRA AND OPTICAL GAPS IN STRONGLY CORRELATED FERMI SYSTEMS
C. Castellani, G. Kotliar (Rutgers Univ., University Park, NJ.), R. Raimondi, M. Grilli, Z. Wang (Rutgers Univ., Piscataway, NJ.), and M. Rozenberg (Rutgers Univ., Piscataway, NJ.) 24 Apr. 1992 19 p
(Contract SC1-0222-C(EDB); NSF DMR-89-15895)
(Preprint-881; ETN-93-92981) Avail: CASI HC A03/MF A01

The single particle and collective excitations near the metal charge transfer insulator transition are analyzed using the slave boson technique. This technique provides a simple picture of the finite charge transfer energy of the strong correlation problem. It is shown that the Mott transition can be interpreted as a softening of an auxiliary boson excitation, which takes place when the gap between the lower and upper Hubbard bands collapses. In the insulating phase the energy of the boson at zero momentum is related to the jumps in the chemical potential at zero doping. The dispersion of the collective modes gives rise to the incoherent Hubbard bands. In a charge transfer insulator this mode describes a p-d charge fluctuation. A similar picture holds for the single band Hubbard model. The Bose field then describes transitions between the lower and the upper Hubbard band. ESA

N93-17018# Rome Univ. (Italy). Dipt. di Fisica.
CALCULATION OF QUANTUM CORRECTIONS TO THE RATE OF SPHALERON TRANSITIONS BY MEANS OF THE ZETA-FUNCTION
R. V. Konoplich (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 24 Apr. 1992 27 p
(Preprint-882; ETN-93-92982) Avail: CASI HC A03/MF A01

The zeta function technique is used to calculate the one loop quantum correction to the rate of sphaleron transitions for a (1 + 1) dimensional Abelian Higgs model in the limit of high temperatures. The zeta function technique for evaluating functional determinants and obtaining the high temperature expansion of the Poeschl-Teller determinant in d dimensions is described. The (1 + 1) dimensional Abelian Higgs model is discussed.

The rate of transitions between different vacua is calculated taking into account one loop quantum corrections. Technical details for the evaluation functional determinants are given. ESA

N93-17020# Rome Univ. (Italy). Dipt. di Fisica.
PROBLEMS WITH THE EUCLIDEAN FORMULATION OF HEAVY QUARK EFFECTIVE THEORIES
U. Aglietti (SISSA, Trieste, Italy), M. Crisafulli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and M. Masetti (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 30 Apr. 1992 9 p
(Preprint-884; ETN-93-92984) Avail: CASI HC A02/MF A01

The formulation in Euclidean space of the effective theory for heavy quarks at non zero velocity, necessary for the implementation of the Isgur-Wise limit in lattice Quantum Chromodynamics simulations, is presented. In this theory the energy spectrum is unbounded from below and, even at the tree level, an ultraviolet cutoff on spatial momenta must be introduced. The continuum limit of the effective quark propagator in configuration space does not exist. Sensible correlation functions in time and in spatial momenta are constructed. The application of the theory to lattice simulations seems very problematic. ESA

N93-17021# Rome Univ. (Italy). Dipt. di Fisica.
EVIDENCE FOR THE DOMINANCE OF AN I(SUP G)J(SUP PC) = 0(+)0(++) RESONANCE IN P(BAR)N DECAY TO 2 PI(+)
Mario Gaspero (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 11 May 1992 35 p Submitted for publication
(Preprint-885; ETN-93-92985) Avail: CASI HC A03/MF A01

The reanalysis of 1496 (bar-p)n decay to 2pi(+)3pi(-) annihilations at rest found that this reaction is dominated by the production of a 4pi resonance with M = 1386 MeV/sq c, Gamma = 310 MeV/sq c, and I(sup G)J(sup PC) = 0(+)0(++), which decays into rho(rho) and sigma(sigma), sigma being the I = 0 S-wave 2pi interaction. The belief that the enhancement seen in this reaction is due to the rho(exp 0)rho(exp 0) decay of the f(sub 2)(1565)(AX) is disproved. The rho(exp 0)rho(exp 0)-(sigma(sigma)) interference reproduces the distribution of the like pion combinations 2pi(+), 2pi(-), and 3pi(-) and this indicates that the interference between resonances and daughters could be one of the dynamical mechanisms which generate the Bose-Einstein correlation. This resonance is probably also responsible for the 0(+) wave dominance at the rho(rho) threshold in the reaction gamma-gamma decay to rho(+)(rho(-)). The name proposed for it is S(sub 0)(1385). ESA

N93-17022# Rome Univ. (Italy). Dipt. di Fisica.
THE b QUARK POLARIZATION AT LEP
Barbara Mele (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 14 May 1992 5 p Presented at 27th Rencontres de Moriond on QCD and High Energy Hadronic Interactions, Les Arcs, France, 22-28 Mar. 1992
(Preprint-886; ETN-93-92986) Avail: CASI HC A01/MF A01

The b quarks are produced with a high longitudinal polarization at the Large Electron Positron (LEP) collider. A possible strategy for detecting some polarization effects through the study of the leptonic energy spectrum in the inclusive semileptonic decay of b hadrons is suggested. The large theoretical uncertainties coming from the only partial knowledge of the b fragmentation function can be controlled by making use of both LEP data and lower energy PETRA (German acronym for Positron Electron Tandem Storage Ring) data on b production. Theoretical and experimental results are compared. ESA

N93-17023# Rome Univ. (Italy). Dipt. di Fisica.
INVESTIGATION OF NEUTRINO PROPERTIES IN THE PROCESS E(+)E(-) DECAY TO NU-NU(BAR)-GAMMA
D. Fargion (Istituto Nazionale di Fisica Nucleare, Rome, Italy), R. V. Konoplich (Moscow Physical-Engineering Inst., USSR), and R. Mignani (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 21 May 1992 7 p
(Preprint-887; ETN-93-92987) Avail: CASI HC A02/MF A01

Assuming a nonvanishing neutrino magnetic moment mu, the tau-neutrino properties are investigated in the process positron-electron decay to nu(bar-nu)(gamma) from the single photon searches at colliders. For a large value of neutrino mass the interference between the diagrams with Z(sup 0) and gamma exchange becomes important and should be taken into account in the positron-electron experiments. Some cosmological and astrophysical impliciations of this new heavy neutrino scenario are discussed. ESA

N93-17033# Boston Univ., MA. Dept. of Chemistry.
STUDY OF INTERMEDIATES FROM TRANSITION METAL EXCITED-STATE ELECTRON-TRANSFER REACTIONS
M. Z. Hoffman 31 Jul. 1992 19 p
(Contract DE-FG02-86ER-13603)
(DE93-001681; DOE/ER-13603/6) Avail: CASI HC A03/MF A01

Conventional and fast-kinetics techniques of photochemistry, photophysics, radiation chemistry, and electrochemistry were used to study the intermediates involved in transition metal excited-state electron-transfer reactions. These intermediates were excited state of Ru(II) and Cr(III) photosensitizers, their reduced forms, and species formed in reactions of redox quenchers and electron-transfer agents. Of particular concern was the back electron-transfer reaction between the geminate pair formed in the redox quenching of the photosensitizers, and the dependence of its rate on solution medium and temperature in competition with transformation and cage escape processes. DOE

N93-17044# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Physics.
MAXIMAL CP VIOLATION VIA HIGGS-BOSON EXCHANGE
L. Lavoura Mar. 1992 16 p
(Contract DE-FG02-91ER-40682)
(DE93-002417; DOE/ER-40682/2; CMU-HEP-92-07) Avail: CASI HC A03/MF A01

The unitarity of the mixing matrix of the charged Higgs bosons, and the orthogonality of the mixing matrix of the neutral Higgs bosons, are used to derive upper bounds on the values of general CP-violating expressions. The bounds are independent of the total number of Higgs fields in any specific model. They allow us to relax the usual assumption of only one Higgs boson being light. It is natural that the CP violation in the exchange of neutral Higgs bosons between bottom quarks be particularly large. DOE

N93-17069# Rome Univ. (Italy). Dipt. di Fisica.
CHIRAL WEAK LAGRANGIAN FOR VECTOR MESONS AND K DECAY TO 3 PI DECAY AMPLITUDES
Gino Isidori (Istituto Nazionale di Fisica Nucleare, Rome, Italy) and Alessandra Pugliese (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 12 Dec. 1991 19 p
(Preprint-849; ETN-93-92951) Avail: CASI HC A03/MF A01

The next order corrections to weak chiral lagrangian induced by vector meson exhange is investigated. Their effects in K decay to 3 pi amplitudes are discussed. The result is a substantial improvement of the lowest order predictions. The lowest order chiral lagrangians for strong and weak interactions are reviewed. The vector meson fields in the strong interactions are given. The weak lagrangian for vector mesons and the property of the induced O(p(exp 4)) pseudoscalar lagrangian are presented. The amplitudes for K decay to 2 pi and K decay to 3 pi first at lowest order and successively adding the p(exp 4) corrections are calculated and the results are compared with the experimental data. ESA

N93-17070# Rome Univ. (Italy). Dipt. di Fisica.
AN EXPLORATORY STUDY OF MESON SPECTROSCOPY AND MATRIX ELEMENTS WITH AN IMPROVED FERMION ACTION AT BETA = 6.0
G. Martinelli (Istituto Nazionale di Fisica Nucleare, Rome, Italy), C. T. Sachrajda (Southampton Univ., England), G. Salina (Southampton Univ., England), and A. Vladikas (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 12 Dec. 1991 34 p Sponsored in part by Italian Ministry of University Research and Science and Technology; Istituto Nazionale di Fisica Nucleare; United Kingdom Science and Engineering Research Council; and EEC
(Preprint-850; SHEP-91/92-6; ETN-93-92952) Avail: CASI HC A03/MF A01

A numerical study of meson masses and current matrix elements is carried out. It is performed in quenched quantum chromodynamics on a 20 by 100 by 40 lattice using an improved action. For comparison the corresponding quantities were computed on the same gauge field configurations using the standard Wilson action. The most remarkable effect appeared in the calculation of the neutral K-neutral K-bar matrix element, for which there is an improvement in its chiral behavior. With the improved

action the result of f(sub pi)/m(sub rho) is in good agreement with the physical value. The basics of improvement and the features of the numerical simulation are presented. The results of meson masses and decay constants, and the implications are discussed. The Kaon's B parameter and the decay constant of a heavy light pseudoscalar meson, obtained using the static approximation, are presented. ESA

N93-17073# Rome Univ. (Italy). Dipt. di Fisica.
TWO LOOP CALCULATION OF THE ANOMALOUS DIMENSION OF FOUR-FERMION OPERATORS WITH STATIC HEAVY QUARKS
V. Gimenez 12 Mar. 1992 52 p Sponsored by Ministerio de Education y Ciencia, Spain
(Preprint-873; ETN-93-92973) Avail: CASI HC A04/MF A01

In the effective field theory for static heavy quarks, the two loop anomalous dimension of the four fermion operator O(sub(delta B = 2)), relevant to the measurement of the B parameter of the B meson on the lattice, is calculated. For N = 3, the second coefficient gamma(sub(delta B = 2)) is equal to -1/36 (202 + 26 xi(2) - 16 n(sub F)). The calculation was performed by means of the techniques already developed to treat the two loop renormalization of the axial current involving static heavy quarks. Dimensional reduction is the method of regularization used. Some theoretic subtleties of this prescription when applied to static heavy quark are exposed. The complete scheme independent order alpha correction to the relationship between the operator O(sub(delta (B = 2))) in the full theory and its counterpart O-bar(sub(delta B = 2)) in the effective theory is derived. ESA

N93-17078# Tennessee Univ., Knoxville. Dept. of Physics.
CORRELATION IN PHOTODETACHMENT
D. J. Pegg 1992 11 p
(Contracts DE-FG05-85ER-13456; DE-AC05-84OR-21400)
(DE93-001843; DOE/ER-13456/44) Avail: CASI HC A03/MF A01

Electron correlation plays a major role in all aspects of the photodetachment of an electron from a negative ion. Photodetachment measurements are well suited to investigate the relatively short range forces associated with correlation due to the absence of the long range Coulomb interaction. Measurements of electron affinities, asymmetry parameters, and cross sections are described to illustrate the influence of correlation on photodetachment. DOE

N93-17175# Argonne National Lab., IL.
CLUSTER-MOLECULE SYSTEMS: ANALYSIS AND TUNING OF THE INTERACTION POTENTIAL
J. Jellinek and Z. B. Guevenc 16 Sep. 1992 6 p Presented at the 6th International Symposium on Small Particles and Inorganic Clusters, Chicago, IL, 16-22 Sep. 1992
(Contract W-31-109-eng-38)
(DE93-000601; ANL/CP-774; CONF-920921-3) Avail: CASI HC A02/MF A01

The interaction (modeled by a LEPS potential) of a D2 molecule with an icosahedral Ni13 cluster is mapped and analyzed in the form of equipotential contour plots. The topological features of the map correlate with the energetic and dynamical characteristics of the dissociative adsorption of the molecule on the cluster, which were extracted from quasiclassical trajectory simulations. A modification of the LEPS potential used originally is introduced. It brings the calculated reactivity of the cluster into agreement with the experimental data. DOE

N93-17181# Lawrence Livermore National Lab., CA.
SPECTROSCOPY OF HIGHLY CHARGED MULTI-ELECTRON IONS
P. Beiersdorfer 16 Sep. 1992 10 p Presented at the 6th International Conference on Physics of Highly Charged Ions, Manhattan, KS, 28 Sep. - 2 Oct. 1992
(Contract W-7405-eng-48)
(DE93-001617; UCRL-JC-111468; CONF-920948-3) Avail: CASI HC A02/MF A01

Systematic studies of highly charged neonlike and nickellike ions as well as several open-shell ions performed on an electron beam ion trap are described and used to assess the accuracy of structure calculations of multi-electron ions. Discrepancies are found that can be attributed to inaccuracies in accounting for electron correlations and in estimating quantum electrodynamical effects. Documenting the effects of level crossings, we demonstrate that these discrepancies are compounded by uncertainties in assigning the respective contributions from quantum electrodynamics to each of the two strongly interacting levels undergoing the crossing. DOE

N93-17200# Carnegie-Mellon Univ., Pittsburgh, PA.
SOLUTIONS TO THE STRONG-CP PROBLEM IN A WORLD WITH GRAVITY
Richard Holman (California Univ., Santa Barbara.), Stephen D. H. Hsu (California Univ., Santa Barbara.), Thomas W. Kephart (Vanderbilt Univ., Nashville, TN.), Edward W. Kolb (California Univ., Santa Barbara.), Richard Watkins (Fermi National Accelerator Lab., Batavia, IL.), and Lawrence M. Widrow (California Univ., Santa Barbara.) Jan. 1992 6 p
(Contracts DE-FG02-91ER-40682; DE-AC02-76ER-03066; DE-FG05-85ER-40226)
(DE93-002650; DOE/ER-40682/19; NSF-ITP-92-06; CMU-HEP-92-05; HUTP-92A011; FNAL/Pub-92/34-A) Avail: CASI HC A02/MF A01

We examine various solutions of the strong-CP problem to determine their sensitivity to possible violations of global symmetries by Planck scale physics. While some solutions remain viable even in the face of such effects. Violations of the Peccei-Quinn (PQ) symmetry by non-renormalizable operators of dimension less than 10 will generally shift the value of (bar (theta)) to values inconsistent with the experimental bound (bar (theta)) approximately less than 10 exp -9. We show that it is possible to construct axion models where gauge symmetries protect PQ symmetry to the requisite level. DOE

N93-17213# Rome Univ. (Italy). Dipt. di Fisica.
MESON SPECTROSCOPY AND DECAY CONSTANTS WITH WILSON FERMIONS AT BETA = 6.4
A. Abada (Centre National de la Recherche Scientifique, Orsay, France), C. R. Allton (Southampton Univ., England), P. Boucaud (Centre National de la Recherche Scientifique, Orsay, France), D. B. Carpenter (Southampton Univ., England), M. Crisafulli, J. Galand (Centre National de la Recherche Scientifique, Orsay, France), S. Guesken (Wuppertal Univ., Germany), G. Martinelli, O. Pene (European Organization for Nuclear Research, Geneva, Switzerland), and C. T. Sachrajda (Southampton Univ., England) et al 7 Oct. 1991 44 p Sponsored in part by United Kingdom Science and Engineering Research Council; EEC; Italian Ministry of University Research and Science and Technology; and Istituto Nazionale di Fisica Nucleare
(Preprint-823; CERN-TH-6271/91; LPTHE-ORSAY-91/36; SHEP-91/92-3; ETN-93-92927) Avail: CASI HC A03/MF A01

A lattice study of the physical properties of mesons composed of a heavy, Q, and a light, q, quark, at beta = 6.4 in a 13,824 by 60 lattice is carried out. The Wilson action in the quenched approximation is used. The mass spectrum and the decay constants of vector and pseudoscalar mesons are studied. Violations of the mass scaling law f(sub P) square root of M(sup P) = constant are found. The results using quenched but propagating quarks are consistent with the static results when the scale is taken from the pion decay constant. Combining the results obtained by several calculations of the pseudoscalar decay constants as a function of the meson mass, at different values of the lattice spacing, f(sub B) square root of B(sub B) = (220 +/- 40) MeV is obtained. The vector pseudoscalar mass splittings do not follow the predicted behavior, which is expected in the limit of large heavy quark masses. ESA

N93-17222# Rome Univ. (Italy). Dipt. di Fisica.
EVIDENCE OF AN I(SUP G)J(SUP PC) = O(+)O(++) RESONANCE AT 1.39 GeV/SQ C AND CONFUTATION OF THE ZETA(1480) IN A REANALYSIS OF THE P(BAR)N DECAY TO 2 PI(+)-3 PI(-) ANNIHILATION AT REST
Mario Gaspero (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 2 Oct. 1991 11 p Presented at Workshop on Nucleon-Antinucleon Interaction, Moscow, Russia, 8-11 Jul. 1991
(Preprint-826; ETN-93-92930) Avail: CASI HC A03/MF A01

By the reanalysis of 1496 p(bar)-n decay to 2pi(+)-3pi(-) annihilations at rest it was found that the reaction was dominated by a 4pi resonance with I(sup G)J(sup PC) = O(+)O(++) and predominant decay sigma-sigma. This disproves the belief that the enhancement seen in this reaction is the 2pi(+)-2pi(-) decay of the f(sub 2)(1565). The resonance also decays into rho-rho, and the (rho neutral-rho neutral)-(sigma-sigma) interference is constructive at low masses in the 2pi(+), 2pi(-) and 3pi(-) distributions and

at cos theta greater than zero in the 2pi(+) and 2pi(-) angular distributions. This reproduces the behavior foreseen by the Bose-Einstein correlation. ESA

N93-17231# Fermi National Accelerator Lab., Batavia, IL.
HIGH ENERGY ELASTIC AND DIFFRACTIVE SCATTERING
S. Shukla Aug. 1992 30 p Presented at the International Conference on Physics in Collisions, Boulder, CO, 9-12 Jun. 1992
(Contract DE-AC02-76CH-03000)
(DE93-000762; FNAL/C-92/232; CONF-9206292-1) Avail: CASI HC A03/MF A01

The developments in high energy pp and p(bar p) elastic scattering in the last 30 years are summarized. The Regge pole model and the geometrical models are reviewed and their agreement with experimental data discussed. The experimental method for measuring the total cross section and the ratio of the real to the imaginary part of the forward elastic scattering amplitude, p, is described. The asymptotic behavior of the total cross section at high energy is discussed in the light of the new results on p(bar p) elastic scattering at sq. root of s = 1.8 TeV. Predictions from geometrical models and Regge phenomenology are compared with experimental data. The 2-gluon model of the Pomeron by Low and Nussinov is discussed. Future measurements on elastic pp and p(bar p) elastic scattering are discussed. DOE

N93-17345# Oak Ridge National Lab., TN.
LOW-ENERGY MEASUREMENTS OF ELECTRON CAPTURE BY MULTICHARGED IONS FROM EXCITED HYDROGEN ATOMS
C. C. Havener, M. A. Haque (Alcorn State Univ., Lorman, MS.), A. C. H. Smith (University Coll., London, England), and X. Urbain (Universite Catholique de Louvain, Belgium) 1992 10 p Presented at the 6th International Conference on Physics of Highly Charged Ions, Manhattan, KS, 28 Sep. - 2 Oct. 1992
(Contracts DE-AC05-84OR-21400; DE-AC05-76OR-00033)
(DE93-001642; CONF-920948-5) Avail: CASI HC A02/MF A01

For very low collision energies electron capture from excited hydrogen by multicharged ions is characterized by enormous cross sections, the predicted maximum being comparable to the geometric size of the Rydberg atom. The ion-atom merged-beams technique is being used to study these collisions for the variety of charge states and the wide range of energies (0.1 to 1000 eV/amu) accessible to the apparatus. A neutral D beam containing a Rydberg atom population proportional to 1/cu n is produced by collisional electron detachment of 8 key D(-) in N2 gas. An applied electric field results in a truncation of the maximum principal quantum number present in the beam in the range (n = 24-11) depending on the strength of the field applied. This beam is then merged with O(3+) or O(5+) ion beams at low relative collision velocities where the resultant beam-beam signal of D(+) due to electron loss is dominated by electron capture. From the sharp decrease in the observed beam-beam signal as the electric field increases it is inferred that the electron capture cross section scales as n(4) increasing towards n(5) for collision energies below 1 eV/amu. DOE

N93-17362# Superconducting Super Collider Lab., Dallas, TX.
RELIABILITY OF NUMERICAL SOLUTIONS OF A DIFFUSION EQUATION MODELING rf NOISE-INDUCED DILUTION IN PARTICLE BEAMS
H. J. Shih, W. Schiesser, and J. Ellison (New Mexico Univ., Albuquerque.) Oct. 1992 16 p Presented at the 7th International Association of Mathematics and Computer Simulation International Conference on Computer Methods for Partial Differential Equations, New Brunswick, NJ 22-24 Jun. 1992
(Contract DE-AC35-89ER-40486)
(DE93-000837; SSCL-Preprint-138-Rev-1; CONF-9206185-10-Rev-1) Avail: CASI HC A03/MF A01

The dilution process in particle beams caused by noise in the rf accelerating system has been modeled using a diffusion equation. Particle tracking can also be undertaken to determine the effects of rf noise, though it is much more computationally extensive than integrating the diffusion equation. We present the integration results using the Method of Lines (MOL) for certain important classes of noise. We will describe the numerical algorithms in detail, including those that are made to remove anomalous solutions. Reliability of the numerical results will be checked using both finite-difference and finite-element (Galerkin) methods in discretization and applying the same algorithms to the cases of linear and quadratic diffusion coefficients where exact solutions are known. DOE

N93-17371# Los Alamos National Lab., NM.
DIRECTIONAL FAST-NEUTRON DETECTORS
A. Garnett, ed. Oct. 1992 38 p
(Contract W-7405-eng-36)
(DE93-000355; LA-12379-MS) Avail: CASI HC A03/MF A01

Because neutrons are uncharged, neutron detectors must usually employ massive shielding in order to provide narrow angular resolution or to reduce the effect of backgrounds incident from different directions. If a detector is divided into multiple elements, the differences in count rate between different segments can indicate the direction of the incident neutron flux or provide corrections that cancel out the detector's response in certain directions. This report presents several calculations for this 'active' collimation, which requires the use of much less shielding material than comparable passive approaches. Included are calculations for well-shielded detectors whose response is nonzero only over a narrow angular range, lightly shielded detectors whose response is zero over the entire rear hemisphere, and unshielded detectors that can accurately determine the direction of a suspected neutron source. These calculations are compared with available measurements and are in good-to-excellent agreement. DOE

N93-17373# Oak Ridge National Lab., TN. Solid State Div.
RESONANCE ELECTRON SCATTERING BY ADSORBED MOLECULES: (SIGMA)* RESONANCE ENERGY VERSUS BOND LENGTH
L. Siller (Cambridge Univ., England), K. M. Hock (Cambridge Univ., England), R. E. Palmer (Cambridge Univ., England), and J. F. Wendelken 1992 13 p Presented at the 12th International Vacuum Congress, Hague, Netherlands, 12-16 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-000445; CONF-9210161-3) Avail: CASI HC A03/MF A01

The paper explores the relationship between the energy of the (sigma)* negative ion resonance, observed in the cross-section for vibrational excitation of small molecules in electron energy loss spectroscopy (EELS) and the intramolecular bond length. On the basis of experimental results assembled from studies of electron scattering by both fire and adsorbed molecules containing the C-O group, we find an approximately linear empirical correlation between the resonance energy and the C-O bond length. This correlation is accurately reproduced by multiple scattering X(alpha) calculations for the free CO molecule as a function of bond length, suggesting the possible determination of molecular bond lengths from the (sigma)* resonance energies obtained in EELS. Similar calculations are reported for N2 and O2 in addition to CO. DOE

N93-17374# Lawrence Livermore National Lab., CA.
FUTURE DIRECTIONS IN ELECTRON-ION COLLISION PHYSICS
K. J. Reed, ed. 1992 211 p Presented at the Future Direction in Electron-Ion Collision Physics, Atlanta, GA, 9-10 Apr. 1992
(Contract W-7405-eng-48)
(DE93-000500; CONF-9204186) Avail: CASI HC A10/MF A03

This report discusses the following topics: summary of session on synergistic coordination of theory and experiment; synergism between experiment and theory in atomic physics; comparison of theory and experiment for electron-ion excitation and ionization; summary of session on new theoretical and computational methods; new theoretical and computational methods-r-matrix calculations; the coulomb three-body problem: a progress report; summary of session on needs and applications for electron-ion collisional data; electron-ion collisions in the plasma edge; needs and applications of theoretical data for electron impact excitation; summary of session on relativistic effects, indirect effects, resonance, etc; direct and resonant processes in electron-ion collisions; relativistic calculations of electron impact ionization and dielectronic recombination cross section for highly charged ions; electron-ion recombination in the close-coupling approximation; modified resonance amplitudes with strongly correlated channels; a density-matrix approach to the broadening of spectral lines by autoionization, radiative transitions and electron-ion collisions; towards a time-dependent description of electron-atom/ion collisions: two electron systems; and comments on inclusion of the generalized bright interaction in electron impact excitation of highly charged ions. DOE

N93-17375# Argonne National Lab., IL. Materials Science Div.
SPIN STRUCTURES OF Fe/Gd AND Fe/Cr MULTILAYERS DETERMINED BY POLARIZED NEUTRON REFLECTOMETRY
M. Loewenhaupt (Forschungszentrum Juelich G.m.b.H., Germany), W. Hahn (Forschungszentrum Juelich G.m.b.H., Germany), Y. Y. Huang, G. P. Felcher, and S. S. P. Parkin (International Business Machines Corp., San Jose, CA.) Aug. 1992 15 p Presented at the Symposium on Magnetic Ultrathin Films, Multilayers, and Surfaces, Lyon, France, 7-10 Sep. 1992
(Contract W-31-109-eng-38)
(DE93-000510; ANL/CP-77178; CONF-9209227-2) Avail: CASI HC A03/MF A01

Polarized neutron reflection was used to determine the magnetic structure of two different antiferromagnetically coupled multilayer systems: Fe/Gd and Fe/Cr. In Fe/Gd, the Fe and Gd moments are coupled antiparallel at the interface. At low temperatures a surface induced magnetic phase transition was found. In Fe/Cr, annealing at temperatures of up to 425 C, resulted in the degrading of antiferromagnetic coupling between Fe layers and in the formation of ferromagnetically coupled regions. DOE

N93-17381# Los Alamos National Lab., NM.
EQUILIBRIUM CHARGE STATE DISTRIBUTIONS OF 1-30 keV ATOMIC PROJECTILES TRANSITING THIN CARBON FOILS
H. O. Funsten, B. L. Barraclough, and D. J. McComas 1992 12 p Presented at the 8th International Conference on Ion Beam Modification of Materials, Heidelberg (Germany), 7-11 Sep. 1992
(Contract W-7405-eng-36)
(DE93-000792; LA-UR-92-2913; CONF-9209200-5) Avail: CASI HC A03/MF A01

We have investigated the exit charge state distributions of 1-30 keV H, He, C, N, O, Ne, and Ar ions that transit thin carbon foils. In this velocity regime which is less than the Bohr velocity, the dominant charge states are neutrals and singly positive ions. Therefore, the charge state distributions are dependent primarily on electron loss by neutrals with an associated electron loss cross section sigma(sub 1) and electron capture by singly ionized species with an associated electron capture cross section sigma(sub c). Using empirical charge state distributions, the ratio sigma(sub 1)/sigma(sub c) is shown to have a quadratic dependence on the projectile velocity and is fit to the equation A(E(sub F)-E(sub T))/m where E(sub F) is the exit projectile energy, m is its mass, and A and E(sub T) are constants. A pronounced shell effect is observed: the constant A is dependent on the principle quantum number of the projectile, and E(sub T) depends on the number of projectile valence electrons. DOE

N93-17396# Amsterdam Univ. (Netherlands).
A SPECTATOR MODEL FOR DEEP INELASTIC ELECTRON SCATTERING Ph.D. Thesis
Herman Meyer 1992 100 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie, and Netherlands Organization for Scientifc Research
(ETN-92-92539) Avail: CASI HC A05/MF A02

The main aspects of Deep Inelastic Scattering (DIS) are discussed. DIS of leptons off hadrons has proved to be an excellent tool for probing the elementary structure of hadrons. It has shown the 'existence' of quarks on the nucleon. The role of the system that is not hit by the virtual photon, the spectator system, is considered. Scale dependence of the structure function, including renormalization and the Gribov Lipatov Altarelli Parisi (GLAP) equations, is described. The diquark spectator model and DIS from nuclear targets are addressed. In conclusion, the spectator model for DIS in its simplest form can be used to quantify many interesting phenomena that are related to nonperturbative aspects of quantum chromodynamics such as the shape of quark and gluon distributions. It could be the starting point for other more detailed applications including higher twist contributions and possible dynamical approaches to quark-gluon interactions. ESA

N93-17399# Groningen Rijksuniv. (Netherlands). Kernfysisch Versneller Inst.
THE PION CONTRIBUTION TO SEMI-INCLUSIVE DEEP INELASTIC SCATTERING WITH SLOW BARYONS IN THE FINAL STATE
C. L. Korpa, A. E. L. Dieperink, and O. Scholten 1992 9 p Submitted for publication
(KVI-881; ETN-92-92542) Avail: CASI HC A02/MF A01

The pion exchange contribution to the semi-inclusive lepto-production on protons, with a slow nucleon or delta in the final state, is analyzed. The ratios of the production of nucleons and deltas of different isospin states are calculated. The results are compared with a recent experiment and with predictions of the string fragmentation model. Experiments to further test the relevance of the pion contribution to semi-inclusive deep inelastic scattering are discussed. ESA

N93-17400# Groningen Rijksuniv. (Netherlands). Kernfysisch Versneller Inst.
ESCAPE- AND SPREADING WIDTH OF THE ISOBARIC ANALOG STATE
S. Y. vanderWerf 1991 8 p Presented at 6th International Conference on Nuclear Reactions and Mechanisms, Varenna, Italy, 10-15 Jun. 1991 Sponsored by Netherlands Organization for Scientific Research
(KVI-884; ETN-92-92543) Avail: CASI HC A02/MF A01

Data and systematics on the natural line width, the escape width, and the spreading width of ground state isobaric analog states are presented. The relation between isospin impurity and spreading width, and between escape width and neutron spectroscopic factors is discussed. The neutron decay, possible only through isospin breaking, was measured directly and is found to have a mostly statistical spectral shape. ESA

N93-17464# Oak Ridge National Lab., TN.
EQUILIBRIUM AND PRE-EQUILIBRIUM MODELS FOR CALCULATION OF PARTICLE EMISSION CROSS SECTIONS AND SPECTRA
C. Y. Fu 1992 10 p Presented at the Symposium on Nuclear Data Evaluation Methodology, Upton, NY, 12-16 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001635; CONF-921046-4) Avail: CASI HC A02/MF A01

Improvements of equilibrium and pre-equilibrium models that were applied to the evaluations of the recently released nuclear data libraries are reviewed. The improvements include energy-angle correlated neutron emission in the continuum, charged-particle and recoil spectra, widths-fluctuation correction for the continuum, pre-equilibrium capture, and gamma-ray strength functions. Their impacts on evaluated data are summarized. DOE

N93-17469# Institute for Advanced Study, Princeton, NJ.
PROBLEMS IN PARTICLE THEORY
S. L. Adler and F. Wilczek Nov. 1992 19 p
(Contract DE-FG02-90ER-40542)
(DE93-003687; DOE/ER-40542/73) Avail: CASI HC A03/MF A01

Members of the institute have worked on a number of problems including the following: acceleration algorithms for the Monte Carlo analysis of lattice field, and gauge and spin theories, based on changes of variables specific to lattices of dimension 2(sup ell); construction of quaternionic generalizations of complex quantum mechanics and field theory; wave functions for paired Hall states; black hole quantum mechanics; generalized target-space duality in curved string backgrounds; gauge symnmetry algebra of the N = 2 string; two-dimensional quantum gravity and associated string theories; organizing principles from which the signal processing of neural networks in the retina and cortex can be deduced; integrable systems of KdV type; and a theory for Kondo insulators. DOE

N93-17475# Boston Univ., MA. Dept. of Physics.
RESEARCH IN PARTICLE PHYSICS
Sep. 1992 167 p
(Contract DE-FG02-91ER-40676)
(DE92-041135; DOE/ER-40676/2) Avail: CASI HC A08/MF A02

Research accomplishments and current activities of Boston University researchers in high energy physics are presented. Principal areas of activity include the following: detectors for studies of electron-positron annihilation in colliding beams; advanced accelerator component design, including the superconducting beam inflector, electrostatic quadrupoles, and the 'electrostatic muon kicker'; the detector for the MACRO (Monopole, Astrophysics, and Cosmic Ray Observatory) experiment; neutrino astrophysics and the search for proton decay; theoretical particle physics (electroweak and flavor symmetry breaking, hadron collider phenomenology, cosmology and astrophysics, new field-theoretic models, nonperturbative investigations of quantum field theories, electroweak interactions); measurement of the anomalous magnetic moment of the muon; calorimetry

for the GEM experiment; and muon detectors for the GEM experiment at the Superconducting Super Collider. DOE

N93-17483# Argonne National Lab., IL.
CHARGED-PARTICLE BEAM DIAGNOSTICS FOR THE ADVANCED PHOTON SOURCE (APS)
A. H. Lumpkin, G. Decker, E. Kahana, D. Patterson, W. Sellyey, X. Wang, and Y. Chung 1992 17 p Presented at the 14th International Free Electron Laser Conference, Kobe, Japan, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE93-001855; ANL/CP-76107; CONF-9208142-7) Avail: CASI HC A03/MF A01

Plans, prototypes, and initial test results for the charged-particle beam (e-), e(+) diagnostic systems on the injector rings, their transport lines, and the storage ring for the Advanced Photon Source (APS) are presented. The APS will be a synchrotron radiation user facility with one of the world's brightest x-ray sources in the 10-keV to 100-keV regime. Its 200-MeV electron linac, 450-MeV positron linac, positron accumulator ring, 7-GeV booster synchrotron, 7-GeV storage ring, and undulator test lines will also demand the development and demonstration of key particle-beam characterization techniques over a wide range of parameter space. Some of these parameter values overlap or approach those projected for fourth generation light sources (linac-driven FELs and high brightness storage rings) as described at a recent workshop. Initial results from the diagnostics prototypes on the linac test stand operating at 45-MeV include current monitor data, beam loss monitor data, and video digitization using VME architecture. DOE

N93-17485# Argonne National Lab., IL.
FAST NEUTRON SCATTERING NEAR SHELL CLOSURES: SCANDIUM
A. B. Smith and P. T. Guenther Aug. 1992 38 p
(Contract W-31-109-eng-38)
(DE93-002090; ANL/NDM-125) Avail: CASI HC A03/MF A01

Neutron differential elastic- and inelastic-scattering cross sections are measured from approximately 1.5 to 10 MeV with sufficient detail to define the energy-averaged behavior of the scattering processes. Neutrons corresponding to excitations of 465 +/- 23, 737 +/- 20, 1017 +/- 34, 1251 +/- 20, 1432 +/- 23, and 1692 +/- 25 keV are observed. It is shown that the observables, including the absorption cross section, are reasonably described with a conventional optical-statistical model having energy-dependent geometric parameters. These energy dependencies are alleviated when the model is extended to include the contributions of the dispersion relationship. The model parameters are conventional, with no indication of anomalous behavior of the neutron interaction with Sc-45, five nucleons from the doubly closed shell at Ca-40. DOE

N93-17487# Rockefeller Univ., New York, NY.
RESEARCH PROGRAMS ON ELEMENTARY PARTICLE AND FIELD THEORIES AND SUPERCONDUCTIVITY
N. N. Khuri 1992 26 p
(Contract DE-FG02-91ER-40651)
(DE93-003147; DOE/ER-40651/2; RU-92/16/B) Avail: CASI HC A03/MF A01

Research of staff members in theoretical physics is presented in the following areas: super string theory, a new approach to path integrals, new ideas on the renormalization group, nonperturbative chiral gauge theories, the standard model, K meson decays, and the CP problem. Work on high-(Tc) superconductivity and protein folding is also related. DOE

N93-17488# Ohio State Univ., Columbus. Dept. of Physics.
RESEARCH IN ELEMENTARY PARTICLE PHYSICS
1992 81 p
(Contract DE-FG02-91ER-40690)
(DE93-003153; DOE/ER-40690/1) Avail: CASI HC A05/MF A01

Experimental and theoretical work on high energy physics is reviewed. Included are preparations to study high-energy electron-proton interactions at HERA, light-cone QCD, decays of charm and beauty particles, neutrino oscillation, electron-positron interactions at CLEO 2, detector development, and astrophysics and cosmology. DOE

N93-17544# Rome Univ. (Italy). Dipt. di Fisica.
MONTE CARLO SIMULATION OF MINIMUM BIAS EVENTS AT THE LHC ENERGY
Guido Ciapetti (Istituto Nazionale di Fisica Nucleare, Rome, Italy) and Anna DiCiaccio 15 Jan. 1991 10 p Presented at Large Hadron Collider Workshop, Aachen, Germany, 4-9 Oct. 1990
(Nota-Interna-969; ETN-92-92598) Avail: CASI HC A02/MF A01

A good description of the soft hadronic interactions at the Large Hadronic Collider (LHC) energy is a necessary tool to do a realistic feasibility study of the experiments that must be able to disentangle possible rare physics processes from the bulk of proton-proton interactions. Two Monte Carlo generators, Isajet and Pythia, were tuned on the experimental data over the largest presently available range of energies. Their predictions were extrapolated at square root of s = 16 TeV. Assuming a linear increase with log s for relevant quantities of the mean charged multiplicity and of the average transverse momentum, both models give reasonable results. An average charged multiplicity, per unit of pseudorapidity, of 5 to 6 particles and an average transverse momentum around 0.510 and 0.540 GeV/c is expected. The effect of the pile-up of several minimum bias events in the same trigger gate was investigated. Limits on the minimum jet transverse energy and on the minimum value of the isolation cut that can be used in the analysis of rare events was derived. ESA

N93-17575# Rockefeller Univ., New York, NY.
EXPERIMENTAL STUDIES OF ELEMENTARY PARTICLE INTERACTIONS AT HIGH ENERGIES
K. Goulianos 1 Oct. 1992 73 p
(Contracts DE-FG02-91ER-40651; DE-AC02-87ER-40325)
(DE93-003652; DOE/ER-40651/3; RU-92/E-36) Avail: CASI HC A04/MF A01

In the past year, our research program encompassed four major areas: the UA-6 experiment at CERN, the CDF (Collider Detector at Fermilab) experiment at Fermilab, the SDC (Solenoidal Detector Collaboration) experiment of the SSC (Superconducting Super Collider), and an R&D project for the development of High Pressure Gas Calorimetry for high luminosity colliders. The UA-6 experiment studies direct-gamma and J/psi production in pp and (bar p)p interactions at (radical)s = 22.5 GeV. In the CDF experiment we have concentrated in the plug calorimeter upgrade program, which involves replacing the plug and forward calorimetry with a more compact calorimeter based on scintillator tiles being readout with wave-length shifting (WLS) fibers. In the SDC experiment, we have taken primary responsibility for the Preshower/Shower-Maximum detectors. We wrote the original shower-maximum proposal for the SDC and have contributed to detector simulations, scintillator/WLS-fiber light yield measurements, building prototype preshower and shower-maximum detectors and measuring their performance in a test beam, and developing novel photosensitive devices to read out the fibers. The High Pressure Gas Calorimeter project has been very successful. A prototype parallel plate iron based electromagnetic calorimeter was designed, constructed and tested in an electron beam at Fermilab. The results were very encouraging. We are presently working on a new design, which would be more suitable for the construction of economical, large scale calorimeters, such as those needed for the forward region of SDC and FAD. DOE

N93-17600# Helsinki Univ. of Technology, Espoo (Finland). Physics Lab.
POSITRON DYNAMICS IN SOLIDS Ph.D. Thesis
Jari Makinen Helsinki, Finland Finnish Academy of Technology 1991 55 p Sponsored by the Finnish Cultural Foundation and Geophysical Observatory
(Acta-Polytec-Scand-PH-176; ISBN-951-666-334-6; ETN-92-92611) Avail: CASI HC A04/MF A01

The low energy positron beam and positron lifetime spectroscopies were used to investigate positron solid interactions. The topics include positron diffusion in solids, interaction with solid surfaces, and positron annihilation in semiconductors. Coupling of positrons to acoustic phonons is recognized as the dominant scattering mechanism. This is verified experimentally in a wide temperature region from 20 K to the inset of positron trapping at thermal vacancies. Positron motion in electric field in Si was investigated in a surface barrier diode. Below 300 K, the lattice scattering mechanism limiting positron motion is due to acoustic phonons. Positron emission and positronium formation were studied at clean metal

surfaces. The discovery of a rapid decrease of both yields at low temperatures at negative work function surfaces is consistent with wave mechanical reflection of the positron from the surface barrier. Positron trapping at negatively charged centers in electron irradiated silicon was examined using the lifetime technique. A large trapping cross section and a strong temperature dependence of the trapping rate were discovered. This is ascribed to positron trapping at weakly bound Rydberg states in the long range Coulomb potential. The effect of the breathing mode volume relaxation of the phosphorus vacancy pair on positron lifetime was demonstrated. ESA

N93-17605# Minnesota Univ., Minneapolis. School of Physics and Astronomy.

NUCLEAR STRUCTURE STUDIES AT INTERMEDIATE ENERGY

N. M. Hintz, A. Sethi, V. Starodubsky, Xin Hua Yang, M. Franey, and D. Mihaildis Sep. 1992 108 p

(Contract DE-FG02-88ER-40405)

(DE93-003661; DOE/ER-40405/5) Avail: CASI HC A06/MF A02

New experimental results are given for proton elastic and inelastic cross sections for W-(182,186) at 650 MeV, Pb-208 and Ni-60(p,t) cross sections at 120 MeV, a coincidence study of the Ca-40(rvec p,2p) reaction. In addition to the above, data reduction and analysis are also being carried out as follows: global analysis of Si-28 and Ni-58(rvec, p,p') data at 135, 178, 333, 500, and 800 MeV for high-spin stretched states using medium modified interactions (conventional and QCD effective mass modifications); analysis of Pb-(206,207,208)(rvec p,p) elastic data at 650 MeV. Work on development of techniques to study relativistic effects of proton-nucleus scattering at forward angles and extended angular range of S(sub nn) measurements in Ca-40 were also performed. DOE

N93-17624# Carnegie-Mellon Univ., Pittsburgh, PA.

MEASUREMENT OF THE BRANCHING RATIO FOR D(+) YIELDS (BAR-K)*(892)(SUP 0)MU(+)NU

1992 22 p

(Contract DE-FG02-91ER-40682)

(DE93-002414; DOE/ER-40682/5; CMU-HEP-92-10) Avail: CASI HC A03/MF A01

The branching ratio for the decay mode D(sup +) yields (bar K)*(sup 0) (mu)(sup +)(nu) has been measured with two methods. The first uses D(sup 0) yields (bar K) (sup (minus))(mu)(sup +)(nu) for normalization, and yields the result B(D(sup +)) yields (bar K)*(sup 0) (mu)(sup +)(nu) = (3.25 (plus minus) 0.71 (plus minus) 0.75) percent. From this method we also obtain the direct measurement (Gamma)(D(sup +) (yields)(bar K)*(sup 0)(mu)(sup +) (nu)/(Gamma)(D(sup 0) (yields) K(sup (minus)) (mu)(sup +) (nu))= 0.43 (plus minus) 0.09 (plus minus) 0.09. The second method uses the mode D(sup +) (yields) K(sup (minus))(pi)(sup +) (pi)(sup +) for normalization and yields B(D(sup +) (yields) (bar K)*(sup 0) (mu)(sup +)(nu)) = 4.18 +/- 0.66 +/- 0.96) percent. Combining the results of the two methods yields B(D(sup +) (yields) (bar K)*(sup 0)(mu)(sup +)(nu)) = 3.57 +/- 0.96 percent. DOE

N93-17630# Rome Univ. (Italy). Dipartimento di Fisica.

A TWO BODY RELATIVISTIC EQUATION FOR INTERACTING NUCLEONS

M. DeSanctis (Istituto Nazionale di Fisica Nucleare, Rome, Italy) and D. Prosperi (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 20 Mar. 1991 9 p

(Nota-Interna-976; ETN-92-92604) Avail: CASI HC A02/MF A01

A relativistic equation for the study of nuclear systems is proposed. The aim of the work is to modify the Mandelzweig and Wallace equation to allow the correct treatment of the one and two pion exchange processes between nucleons. This equation can be also applied to the exchange of different isovector bosons. If the exchanged bosons are vectorial particles, some additional corrections are required. The starting point of the approach is to search for a quasi potential equation which fits the on-shell scattering amplitude. The effects due to the isovector nature of the pion field are taken into account by an additional contribution to the Green function. The equation can be used to study nuclear interactions both in the momentum and configuration space. ESA

N93-17646# Rome Univ. (Italy). Dipartimento di Fisica.

THE FIRST PARTICLE: THE ELECTRON [LA PRIMA PARTICELLA: L'ELETTRONE]

M. Grilli 27 Feb. 1991 88 p In ENGLISH and ITALIAN

(Nota-Interna-974; ETN-92-92602) Avail: CASI HC A05/MF A01

The discovery of the electron is described. Electricity and electromagnetic theory in the final quarter of the 19th century is outlined. Electrolytic conduction, gaseous conduction, gas discharge, and the electric charge/mass relationship, are discussed. The Zeeman effect, the true discovery of the electron, and the electric charge of the electron are described. ESA

N93-17655# Missouri Univ., Rolla. Div. of Applied Plasma Physics.

EXPERIMENTAL INVESTIGATIONS OF ELECTRON CAPTURE FROM ATOMIC HYDROGEN AND DEUTERIUM BY ALPHA PARTICLES

T. J. Gay and J. T. Park 1992 106 p

(Contract DE-FG02-84ER-53188)

(DE93-002654; DOE/ER-53188/9) Avail: CASI HC A06/MF A02

We report progress made during the period 15 September 1991--14 September 1992 on the project 'Experimental Investigations of Electron Capture from Atomic Hydrogen and Deuterium by Alpha Particles'. In the past year we have developed reliable, narrow energy spread, high-current sources of He(++) based on direct-current magentron and electron-cyclotron resonance discharges. These sources have been proven on our test bench accelerator which has been upgraded to also allow us to test atomic hydrogen effusive targets. We have thus made substantial progress toward our goal of studying single electron capture from atomic hydrogen by doubly-ionized helium. A research plan for the upcoming year is also presented. DOE

N93-17656# Ohio State Univ., Columbus. Research Foundation.

STRONGLY INTERACTING FERMION SYSTEMS Annual Progress Report, 15 Nov. 1992 - 14 Nov. 1993

1992 7 p

(Contract DE-FG02-88ER-45347)

(DE93-002839; DOE/ER-45347/32) Avail: CASI HC A02/MF A01

The research has been concentrated in four areas: Methodology for large-scale or innovative computing; computation of complex structures or properties; many-body fermion systems (but not including superconductors); properties of many-body fermion systems believed to be relevant for high-temperature superconductors. All of these areas we put under the rubric of 'strongly interacting fermions systems'. The first two areas are more concerned with computational aspects and the latter two to specific problems with a stronger analytic aspect. However, in our Proposal Section we return to the appropriateness of the rubric strongly interacting fermions. DOE

N93-17698# Arizona Univ., Tucson. Dept. of Nuclear and Energy Engineering.

METHODS DEVELOPMENT FOR ELECTRON TRANSPORT Final Report, May 1990 - May 1991

Barry D. Ganapol Apr. 1992 145 p Prepared for Calspan-Buffalo Univ. Research Center, NY

(Contract F30602-88-D-0026)

(AD-A257986; RL-TR-92-48) Avail: CASI HC A07/MF A02

This report consists of two code manuals and an article recently published in the proceedings of the American Nuclear Society Mathematics and Computation Topical Meeting held in Pittsburgh. In these presentations, deterministic calculational methods simulating electron transport in solids are detailed. The first method presented (Section 2) is for the solution of the Spencer-Lewis equation in which electron motion is characterized by continuous slowing down theory and a pathlength formulation. The FN solution to the standard monoenergetic transport equation for electron transport with isotropic scattering in finite media is given in Section 3. For both codes, complete flow charts, operational instructions and sample problems are included. Finally, in Section 4, an application of the multigroup formulation of electron transport in an infinite medium is used to verify an equivalent SN formulation. For this case, anisotropic scattering is also included. GRA

N93-17783# Pennsylvania State Univ., University Park.
RELATIVISTIC CALCULATIONS OF EXCITATION AND IONIZATION OF HIGHLY CHARGED IONS BY ELECTRON IMPACT
D. H. Sampson 15 Apr. 1992 13 p
(Contract DE-FG02-90ER-54104)
(DE93-002129; DOE/ER-54104/1) Avail: CASI HC A03/MF A01

Our rapid relativistic atomic structure program and relativistic distorted-wave programs for excitation and ionization of highly charged ions were further improved. The generalized Briet interaction and other QED corrections were added to the atomic structure program, and the speed of the distorted-wave excitation program was increased by over an order of magnitude over what it was when our initial large-scale relativistic calculations of excitation of Ne-like ions were made. The improved programs were then used to calculate collision strengths for 330 transitions in F-like ions with 22 less than or = Z less than or = 92 and 248 transitions in Ni-like ions with 60 less than or = Z less than = 92. We expanded the relativistic collision program to include an option to use atomic structure data by the well-known multi-configuration Dirac-Fock (MCDF) program of Grant and coworkers. This was used in calculating collision strengths for the 45 Delta(n) = 0 transitions with n=2 in Be-like ions with 8 less than or = Z less than or = 92. This relativistic collision strength program was also extended to include an option to include the generalized Breis interaction in the scattering matrix elements and the importance of this for He-like, He-like and Li-like ions with Z = 26, 54 and 92 was studied. The factorization method was applied to ionization. Regardless of the complexity of the ion the ionization cross sections could be written as a sum of the products of a readily calculated coefficient that depends only on ion properties and a hydrogen-like cross section. Work was also done on excitation and ionization by directive and, in some cases spin-polarized electrons, which is of interest for some EBIT experiments and the study of solar flares. We also used our extensive collision strength results to test the reliability of the well-known and widely used Van Regemorter approximation. DOE

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory. For space radiation see *93 Space Radiation.*

N93-15668# California Univ., San Diego, La Jolla.
HIGH ENERGY PHYSICS RESEARCH
J. Branson 1992 7 p
(Contract DE-FG03-90ER-40546)
(DE93-000305; DOE/ER-40546/1) Avail: CASI HC A02/MF A01

This is a progress report on the first year of the five year proposal of the UCSD high energy physics group. The main activity of our group continues to be the L3 experiment at LEP. During the last year in L3, we have worked principally on physics analysis. We have also fulfilled our duties in running the detector and contributing to L3 software and computing. In addition, we have made a major effort toward the development of the GEM detector at the SSC. Our SSC work is done in collaboration with the other UCSD groups which are primarily supported by the NSF. In this progress report, we will review our recent activities and describe the current status of the group. Some of the publications and documents which display the work of our group over the last year are included as appendices. We will also outline our research plan to continue our participation in L3 physics and upgrades and to work on the design and construction of the GEM detector. DOE

N93-15673# Argonne National Lab., IL.
TRANSVERSE PHASE-SPACE EVOLUTION IN NON-STATIONARY CHARGED PARTICLE BEAMS
C. L. Bohn 1992 4 p Presented at the 16th International LINAC Conference, Ottawa, Ontario, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE93-000618; ANL/CP-77399; CONF-9208109-59) Avail: CASI HC A01/MF A01

The transverse dynamics of a nonrelativistic, mismatched, one-dimensional sheet beam propagating through a continuous, linear focusing channel is investigated. The investigation is based on the Fokker-Planck equation in which the relaxation rate and diffusion coefficient are calculated from a simple model of turbulence resulting from charge redistribution. DOE

N93-16022# Superconducting Super Collider Lab., Dallas, TX.
RELIABILITY OF NUMERICAL SOLUTIONS OF A DIFFUSION EQUATION MODELING RF NOISE-INDUCED DILUTION IN PARTICLE BEAMS
H. J. Shih, W. E. Schiesser, and J. A. Ellison (New Mexico Univ., Albuquerque.) Jul. 1992 15 p Presented at the 7th International Association of Mathematics and Computer Simulation (IMACS) International Conference on Computer Methods for Partial Differential Equations, New Brunswick, NJ, 22-24 Jun. 1992
(Contract DE-AC35-89ER-40486)
(DE92-040620; SSCL-Preprint-138; CONF-9206185-10) Avail: CASI HC A03/MF A01

The dilution process in particle beams caused by noise in the RF accelerating system has been modeled using a diffusion equation. Particle tracking can also be undertaken to determine the effects of RF noise, though it is much more computationally extensive than integrating the diffusion equation. In this paper we present the integration results using the Method of Lines (MOL) for certain important classes of noise. We will describe the numerical algorithms in detail, including those that are made to remove anomalous solutions. Reliability of the numerical results will be checked using both finite-difference and finite-element (Galerkin) methods in discretization and applying the same algorithms to the cases of linear and quadratic diffusion coefficients where exact solutions are known. DOE

N93-16110# California Univ., Los Angeles.
THEORETICAL AND EXPERIMENTAL STUDIES IN ACCELERATOR PHYSICS
C. Pellegrini 1992 3 p
(Contract DE-FG03-92ER-40693)
(DE92-040333; DOE/ER-40693/1) Avail: CASI HC A01/MF A01

The work supported by the above referenced grant is a broadly based research program on advanced accelerator physics concepts. Specific areas of research include: (1) nonlinear beam dynamics studies; (2) development of low emittance, high brightness electron sources; (3) development of RF accelerating structures; and (4) studies of laser acceleration, in particular, the inverse free electron laser. The research involves both theoretical and experimental studies and is carried out in collaboration with faculty and students in the UCLA Electrical Engineering Department. DOE

N93-16128# Kent State Univ., OH.
THEORETICAL INTERPRETATION OF HIGH-ENERGY NUCLEAR COLLISIONS
G. Fai Jun. 1992 8 p
(Contract DE-FG02-86ER-40251)
(DE92-040845; DOE/ER-40251/10) Avail: CASI HC A02/MF A01

Nuclear collisions are interpreted theoretically. The nuclear equation of state is studied in a wide energy range. Subnucleonic degrees of freedom are invoked at high energy densities and at short length-scales. Questions of dynamical collision simulations are investigated. Direct support is provided for experiment in the form of collaborative projects. The major objective of this nuclear theory program is a better understanding of the properties of strongly interacting matter on the nuclear energy scale, as manifested in high-energy heavy-ion collisions. DOE

N93-16180# Duke Univ., Durham, NC.
DUKE UNIVERSITY HIGH ENERGY PHYSICS
L. R. Fortney, A. T. Goshaw, and W. D. Walker Jul. 1992 52 p
(Contract DE-FG05-91ER-40665)
(DE92-040340; DOE/ER-40665/1) Avail: CASI HC A04/MF A01

This Progress Report presents a review of the research done in 1992 by the Duke High Energy Physics Group. This is the first year of a three-year grant which was approved by the Office of High Energy Physics at DOE after an external review of our research program during the summer of 1991. Our research is centered at Fermilab where we are involved with two active experiments, one using the Tevatron collider (CDF, the Collider Detector Facility) and the other using a proton beam in the high intensity laboratory (E771, study of beauty production). In addition to these running experiments we are continuing the analysis of data from experiments E735

(collider search for a quark-gluon plasma), E705 (fixed target study of direct photon and Chi meson production), and E597 (particle production from hadron-nucleus collisions). Finally, this year has seen an expansion of our involvement with the design of the central tracking detector for the Solenoidal Detector Collaboration (SDC) and an increased role in the governance of the collaboration. Descriptions of these research activities are presented in this report. DOE

N93-16199# Stanford Linear Accelerator Center, CA.
BEAM LOADING COMPENSATION WITH VARIABLE GROUP VELOCITY
Z. D. Farkas Aug. 1992 3 p Presented at the 16th International LINAC Conference, Ottawa, Onterio, 23-28 Aug. 1992
(Contract DE-AC03-76SF-00515)
(DE93-001810; SLAC-PUB-5879; CONF-9208109-45) Avail: CASI HC A01/MF A01

Consider a section with linearly variable group velocity and a beam pulse shorter than the section fill time. Choose the current amplitude so that the gradient of the last bunch equals the gradient of the first bunch. For beam pulses less than about 15 percent of fill time, the voltage deviation during the beam pulse is small, but as the pulse width increases the voltage deviation also increases. We show that by decreasing the output to input group velocity ratio, we can reduce the first order voltage deviation, and that we can remove the remaining second-order voltage deviation by linearly decreasing the section input power by a small amount starting at beam injection time. This way we can increase the beam pulse width to more than half the fill time, and thereby increase the RF to beam energy transfer efficiency and the luminosity without increasing the voltage deviation. DOE

N93-16340# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
RECONSTRUCTION OF (x, Q SQUARED) AND EXTRACTION OF STRUCTURE FUNCTIONS IN NEUTRAL CURRENT SCATTERING AT HERA
Stan Bentvelsen, Jos Engelen, and Paul Kooijman Jan. 1992 20 p
(NIKHEF-H/92-02; ETN-93-92813) Avail: CASI HC A03/MF A01

A method of extracting the kinematic variables in neutral current deeply inelastic scattering at HERA (German acronym for hadron electron storage ring) is presented. A determination of x and Q(sup 2) using the angles of the electron and current jet only turns out to be remarkably powerful. A method for determining x and Q(sup 2) that is insensitive to initial state radiation is achieved. Structure functions F(sub 2) and xF(sub 3) are extracted and the systematic errors are studied. The use of several (x, Q(sup 2)) reconstruction methods, each with different systematic errors will provide complementarity and redundancy for structure function analysis. ESA

N93-16420# Rome Univ. (Italy). Dipartimento di Fisica.
GRAVITATIONALLY INDUCED SYNCHROTRON RADIATION: A NEW TEST FOR GENERAL RELATIVITY
Daniele Fargion (Technion - Israel Inst. of Tech., Haifa.) 13 Sep. 1991 12 p Presented at ICFA Workshop Meeting, Los Angeles, CA Sponsored by Istituto Nazionale di Fisica Nucleare
(Preprint-822; ETN-93-92909) Avail: CASI HC A03/MF A01

The relativistic radiation by a bunch of n charged particles under stationary gravitational fields is considered. The expected gravitational induced synchrotron emission radiation may reach the total power of 2.185 erg/sec N/10(exp 12)exp 2 gamma/100,000(exp 4) and the monofrequency radio power at the peak of the spectrum, corresponding to a wavelength of 5 m/gamma/100,000(exp 3), P sub em approx. = 1/10(exp 15) erg/sec N/10(exp 12) exp 2 gamma/100,000. The corresponding monochromatic signal flux has a value of 0.53 Jansky N/10(exp 12) exp 2. The equivalence principle for charged leptons and barions and their antiparticles may be tested for the first time. Gravity and electromagnetism coupling, the tensorial behavior of General Relativity and the spin two nature of graviton, can be verified. ESA

N93-16423# Rome Univ. (Italy). Dipartimento di Fisica.
THEORY WORKING GROUP: SUMMARY OF THE RESULTS
Luciano Maiani (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 23 May 1991 15 p Sponsored in part by Ministry of University and Scentific and Technological Research
(Preprint-803; ETN-93-92912) Avail: CASI HC A03/MF A01

The results obtained by the working group of DAFNE are summarized. The most important task concerned the measurement of epsilon'/epsilon, from comparisons of different charge conjugation and space inversion violating decay modes of the K(sub L)-K(sub S) pair produced in phi-decays. The possible contributions of DAFNE to the exploration of processes determined by the chiral dynamics, particularly in K decays, are summarized. The hadronic contributions to the muon g-2 and the contributions of DAFNE's data to spectroscopy are underlined. ESA

N93-16479# Amsterdam Univ. (Netherlands).
THE GLOBAL SECOND LEVEL TRIGGER FOR ZEUS Ph.D. Thesis
Hendrikus Alphonsus Uijterwaal 1992 205 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie and Hamburg Univ.
(ETN-92-92816) Avail: CASI HC A10/MF A03

The Global Second Level Trigger (GSLT), the ZEUS detector, and the data acquisition system are presented. Two detectors are under construction for the HERA (German acronym for hadron electron storage ring) collider: ZEUS and H1. The task of the ZEUS trigger system is to select online whether an event is interesting physics or background. The trigger system is divided into three levels. The results of all component trigger processors are transferred to the global first level trigger or GSLT respectively. The global triggers combine and cross check the information from the various components and decide to accept or reject the event. The experimental environment that the GSLT has to cope with is discussed. The hardware implementation of and the software of the processors in the GSLT are presented. The maximum (empty) event rate that the GSLT can handle is (3.2 +/- 0.2) KHz. The GSLT introduces a latency of 1.3 +/- 0.15 ms. Both numbers agree with expected values of 3.3 kHz and 1.1 ms respectively. The GSLT was integrated with the other components in the ZEUS trigger and data acquisition system. A variety of tests were performed and the results are presented. ESA

N93-16526# California Univ., Berkeley. Lawrence Berkeley Lab.
CONDITIONER FOR A HELICALLY TRANSPORTED ELECTRON BEAM
Changbiao Wang May 1992 17 p Presented at the Advanced Accelerator Concepts Workshop, Port Jefferson, NY, 14-20 Jun. 1992
(Contract DE-AC03-76SF-00098)
(DE92-041169; LBL-32222-Exc; ESG-182; CONF-9206193-11) Avail: CASI HC A03/MF A01

The kinetic theory is developed to investigate a conditioner for a helically imported electron beam. Linear expressions for axial velocity spread are derived. Numerical simulation is used to check the theoretical results and examine nonlinear aspects of the conditioning process. The results show that in the linear regime the action of the beam conditioner on a pulsed beam mainly depends on the phase at which the beam enters the conditioner and depends only slightly on the operating wavelength. In the nonlinear regime, however, the action of the conditioner strongly depends on the operating wavelength and only slightly upon the entrance phase. For a properly chosen operating wavelength, a little less than the electron's relativistic cyclotron wavelength, the conditioner can decrease the axial velocity spread of a pulsed beam down to less than one-third of its initial value. DOE

N93-16527# California Univ., Berkeley. Lawrence Berkeley Lab.
AN INVESTIGATION OF COHERENT QUADRUPOLE BEAM--BEAM EFFECTS
S. Krishnagopal and R. H. Siemann (Stanford Linear Accelerator Center, CA.) Jul. 1992 3 p Presented at the International Conference on High Energy Accelerators, Hamburg, Germany, 20-24 Jul. 1992
(Contracts DE-AC03-76SF-00098; DE-AC03-76SF-00515)
(DE92-041191; LBL-32581; ESG-207; SLAC-PUB-5869; CONF-920706-34) Avail: CASI HC A01/MF A01

We use a new simulation technique that allows us to calculate the beam-beam kick from non-Gaussian beams, to discriminate between the predications of two different theoretical models. Our results are in agreement with one of these models. We employ the simulation to better understand the nature of the coherent effects, and to explore their dependence on damping. We discuss the drawbacks in the other model and suggest improvements. DOE

N93-16531*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SYSTEM MODEL DEVELOPMENT FOR NUCLEAR THERMAL PROPULSION
Nelson A. Hannan (Argonne National Lab., IL.), Brian A. Worley (Oak Ridge National Lab., TN.), James T. Walton, Ken R. Perkins (Brookhaven National Lab., Upton, NY.), John J. Buska (Los Alamos National Lab., NM.), and Dean Dobranich (Sandia National Labs., Albuquerque, NM.) 1992 11 p Presented at the 43d Congress of the International Astronautical Federation, Washington, DC, 28 Aug. - 5 Sep. 1992
(Contract DE-AC05-84OR-21400)
(NASA-TM-108157; NAS 1.15:108157; DE92-041262; CONF-9208154-1)
Avail: CASI HC A03/MF A01

A critical enabling technology in the evolutionary development of nuclear thermal propulsion (NTP) is the ability to predict the system performance under a variety of operating conditions. This is crucial for mission analysis and for control subsystem testing as well as for the modeling of various failure modes. Performance must be accurately predicted during steady-state and transient operation, including startup, shutdown and post operation cooling. The development and application of verified and validated system models has the potential to reduce the design, testing, cost and time required for the technology to reach flight-ready status. Since October 1991, the US Department of Energy (DOE), Department of Defense (DOD) and NASA have initiated critical technology development efforts for NTP systems to be used on Space Exploration Initiative (SEI) missions to the Moon and Mars. This paper presents the strategy and progress of an interagency NASA/DOE/DOD team for NTP system modeling. DOE

N93-16546# Laval Univ. (Quebec). Dept. of Physics.
STUDY OF AN ORBITAL ACCELERATOR FOR ION IMPLANTATION AND OF PROTECTIVE COATINGS FOR MATERIALS Final Report [ETUDE D'UN ACCELERATEUR ORBITAL POUR L'IMPLANTATION IONIQUE ET DES COUCHES PROTECTRICES POUR MATERIAUX]
E. J. Knystautas and R. J. Slobodrian 31 May 1989 35 p In FRENCH
(Contract DSS-31098-8-6044/01-SW)
(CTN-93-60614) Avail: CASI HC A03/MF A01

A study was conducted to examine different possible designs for an ion source and accelerator assembly, suitable for operating in space. Such an assembly could serve to treat products in space such as the surfaces of space structures eroded by micrometeorites and atomic oxygen, and could also be used in ion propulsion research. For treating large surfaces and for propulsion, the ion beam produced must be of a high intensity and cover a large surface, while for studying surface properties and implantation of small samples the beam must be well defined. Two designs are presented, each optimized for one of those two requirements. The first is based on an electron cyclotron resonance source coupled to a short electrostatic acceleration stage. The second is based on a Danfysik 910 source followed by a Wien filter and two stages of electrostatic acceleration. In a related study, the effect of ion beam mixing on the tribologic properties of Cr-coated Armco iron was studied. At an optimal dose of argon ions, the Knoop microhardness, dynamic coefficient of friction, rate of abrasive wear, and corrosion resistance had improved values. An alternative method for increasing microhardness, involving formation of quasi crystalline icosahedric crystals at the surface, was also investigated. The increase in microhardness observed with this method was found to be on the order of 5 pct. CISTI

N93-16646# National Lab. for High Energy Physics, Tsukuba (Japan).
QUADRUPOLE MODES IN LINEARIZED BEAM-BEAM INTERACTION IN e(+)e(-) COLLIDING RINGS
Shuji Matsumoto and Kohji Hirata Jan. 1992 24 p
(DE92-556477; KEK-91-12) Avail: CASI HC A03/MF A01

The dynamic-beta model is extended, incorporating the synchrotron radiation effects. The model yields dynamic-emittance effect. The steady-state envelope matrix is explicitly obtained. Both equal-beam and flip-flop solutions are found. The stability of the steady-state solutions are investigated by numerical calculations. The model illustrates some characteristic features of the beam-beam interaction at e(sup +)e(sup -) colliding rings in spite of containing some qualitatively unrealistic points. DOE

N93-16931# Japan Atomic Energy Research Inst., Tokai.
PROCEEDINGS OF THE SPECIALISTS' MEETING ON HIGH ENERGY NUCLEAR DATA
Tokio Fukahori, ed. Mar. 1992 216 p Presented at the Specialists' Meeting on High Energy Nuclear Data, Tokai, Japan, 3-4 Oct. 1991
(DE92-012299; JAERI-M-92-039; INDC(JPN)-158/L; CONF-9110373)
Avail: CASI (US Sales Only)

This report consists of the Proceedings of the Specialists' Meeting on High Energy Nuclear Data. The meeting was held on October 3-4, 1991, at the Tokai Research Establishment, Japan Atomic Energy Research Institute with the participation of forty-odd specialists, who were the evaluators, theorists, experimentalists, and users of high energy nuclear data including the members of Japanese Nuclear Data Committee. The need of the nuclear data in the high energy region up to a few GeV was stressed in the meeting for many applications, such as spallation neutron sources for radioactive waste treatment, accelerator shielding design, medical isotope production, radiation therapy, the effects of space radiation on astronauts and their equipment, and the cosmic history of meteorites and other galactic substances. Although the neutron nuclear data below 20 MeV have been well evaluated for fission and fusion reactor applications, the nuclear data in the high energy region have never been prepared in Japan. With the view of producing an evaluated high energy nuclear data file, theoretical models and codes, available and necessary measurements, needs of nuclear data, and various applications were reviewed and discussed. The consensus, that the wide collaboration was necessary to produce the evaluated file and should be established, has been obtained. DOE

N93-16932# Oak Ridge National Lab., TN.
IMPROVEMENTS IN MANUFACTURE OF IRIDIUM ALLOY MATERIALS
E. K. Ohriner 1992 6 p Presented at the 10th Symposium on Space Nuclear Power and Propulsion, Albuquerque, NM, 10-14 Jan. 1993
(Contract DE-AC05-84OR-21400)
(DE92-017126; CONF-930103-2) Avail: CASI HC A02/MF A01

Iridium alloys are used as fuel-cladding material in radioisotope thermoelectric generators (RTG's). Hardware produced at the Oak Ridge National Laboratory (ORNL) has been used in Voyager 1 and 2, Galileo, and Ulysses spacecraft. This hardware was fabricated from small, 500-g drop-cast ingots. Porosity in these ingots and the resulting defects in the rolled sheets caused rejection of about 30 percent of the product. An improved manufacturing process was developed with the goal of substantially reducing the level of defects in the rolled sheets. The ingot size is increased to 10 kg and is produced by vacuum arc remelting. In addition, the ingot is hot extruded prior to rolling. Since implementation of the process in 1989, the average rate of rejection of the product has been reduced to below 10 percent. DOE

N93-16986# California Univ., Los Angeles. Dept. of Physics.
EXPERIMENTAL AND THEORETICAL HIGH ENERGY PHYSICS RESEARCH
1992 111 p
(Contract DE-FG03-91ER-40662)
(DE93-001495; DOE/ER-40662/1) Avail: CASI HC A06/MF A02

Progress in the various components of the UCLA High-Energy Physics Research program is summarized, including some representative figures and lists of resulting presentations and published papers. Principal efforts were in the following areas: (1) UCLA hadronization model, PEP4/9 e(+)e(-) analysis, and (bar-P) decay; (2) ICARUS and astroparticle physics (physics goals, technical progress on electronics, data acquisition, detector performance, long baseline neutrino beam from CERN to the Gran Sasso and ICARUS, future ICARUS program, and WIMP experiment with xenon), B physics with hadron beams and colliders, high-energy collider physics, and the phi factory project; (3) theoretical high-energy physics; (4) H dibaryon search, search for K(sub L)(sup 0) yields (pi)(sup 0)(gamma)(gamma) and (pi)(sup 0)(nu)(bar-nu), and detector design and construction for the FNAL-KTeV project; (5) UCLA participation in the experiment CDF at Fermilab; and (6) VLPC/scintillating fiber R & D. DOE

N93-16996# Rome Univ. (Italy). Dipt. di Fisica.
STATUS OF QCD
G. Martinelli (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 3 Dec. 1991 27 p
(Preprint-842; ETN-93-92944) Avail: CASI HC A03/MF A01

Recent experimental and theoretical progress in perturbative and nonperturbative Quantum Chromodynamics (QCD) are reported. The electron-positron annihilation, deep inelastic lepton-hadron scattering and hadron-hadron collisions are considered. The results of non perturbative studies of decay constants and mixing parameters for heavy mesons are presented. The experimental tests of QCD at the Large Electron Positron (LEP) collider are summarized. Related theoretical developments are summarized. New measurements of the structure functions are reported, together with reanalyses of the older EMC and SLAC data. The derivation of the parton densities from the structure functions, the problem of the measurement of the gluon distribution and the behavior of the parton densities at small x are discussed. Collider results for jet physics, W + jets cross sections, W production asymmetry and direct photon production are presented. The problem of heavy flavor production at present and future colliders are discussed. Non perturbative QCD is summarized. The symmetries of the QCD lagrangian in the limit in which the mass of a quark goes to infinity are discussed. This problem is important for the theoretical understanding of the physics of B mesons. New lattice calculations which have important consequences for charge conjugation and space inversion violation in B decay to J/psi K(sub S) are presented. ESA

N93-17064# Sandia National Labs., Albuquerque, NM.
FUNDAMENTALS OF HIGH ENERGY ELECTRON BEAM GENERATION
B. N. Turman, M. G. Mazarakis, and E. L. Neau 1992 13 p Presented at the American Welding Society Meeting, Cambridge, MA, 21-23 Sep. 1992
(Contract DE-AC04-76DP-00789)
(DE93-000745; SAND-92-1938C; CONF-9209238-1) Avail: CASI HC A03/MF A01

High energy electron beam accelerator technology has been developed over the past three decades in response to military and energy-related requirements for weapons simulators, directed-energy weapons, and inertially-confined fusion. These applications required high instantaneous power, large beam energy, high accelerated particle energy, and high current. These accelerators are generally referred to as 'pulsed power' devices, and are typified by accelerating potential of millions of volts (MV), beam current in thousands of amperes (KA), pulse duration of tens to hundreds of nanoseconds, kilojoules of beam energy, and instantaneous power of gigawatts to teffawatts (10(exp 9) to 10(exp 12) watts). Much of the early development work was directed toward single pulse machines, but recent work has extended these pulsed power devices to continuously repetitive applications. These relativistic beams penetrate deeply into materials, with stopping range on the order of a centimeter. Such high instantaneous power deposited in depth offers possibilities for new material fabrication and processing capabilities that can only now be explored. Fundamental techniques of pulse compression, high voltage requirements, beam generation and transport under space-charge-dominated conditions will be discussed in this paper. DOE

N93-17202# Oak Ridge National Lab., TN.
SPACE POWER REACTOR GROUND TEST IN THE EXPERIMENTAL GAS COOLED REACTOR (EGCR) AT OAK RIDGE
M. H. Fontana, R. S. Holcomb, and R. H. Cooper 1992 7 p Presented at the 10th Symposium on Space Nuclear Power and Propulsion, Albuquerque, NM, 10-14 Jan. 1993
(Contract DE-AC05-84OR-21400)
(DE92-016788; CONF-930103-3) Avail: CASI HC A02/MF A01

The Experimental Gas Cooled Reactor (EGCR) facility and the supporting technical infrastructure at the Oak Ridge National Laboratory have the capabilities of performing ground tests of space nuclear power reactor systems. A candidate test would be a 10 MWt lithium cooled reactor, generating potassium vapor that would drive a power turbine. The facility is a large containment vessel originally intended to test the EGCR. Large, contained, and shielded spaces are available for testing, assembly, disassembly, and post-test examination. DOE

N93-17205# Superconducting Super Collider Lab., Dallas, TX.
OBJECT-ORIENTED SIMULATION FOR THE SUPERCONDUCTING SUPER COLLIDER
J. Zhou Jun. 1992 18 p Presented at the Object Oriented Simulation Conference, San Diego, CA, 17-20 Jan. 1992
(Contract DE-AC35-89ER-40486)
(DE92-015962; SSCL-Preprint-122; CONF-930113-1) Avail: CASI HC A03/MF A01

The design and implementation of an object-oriented simulation environment called OZ for the Superconducting Super Collider (SSC) is described. The design applies object-oriented technology to data visualization, behavior modeling, dynamic simulation and version control. A meta class structure is proposed to model different types of objects in large systems by their functionality. OZ provides a direct-manipulation user interface which allows the user to visualize the data as an object in the database and interactively model the component of the system. Modeling can be exercised at different levels of the class hierarchy and then can be dynamically bound into a system for simulation. Inheritance is used to derive new configurations of the system or subsystem from the existing one, and specify an object's behavior. Delegation is used to construct a system by instantiating existing objects and 'stealing' their methods by delegators. The implementation uses C++, GLISTK library, InterViews 2.6, ISTK library, GNU C++ library, GLISH event sequencer, NIH class library, and ObjectStore. DOE

N93-17216# Rome Univ. (Italy). Dipt. di Fisica.
PROBING THE WWZ VERTEX AT 500 GeV E(+)E(-) COLLIDER
S. Ambrosanio and B. Mele (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 16 Oct. 1991 6 p Presented at Workshop on E(+)E(-) Collisions at 500 GeV, the Physics Potential, Hamburg, Germany, 2-3 Sep. 1991
(Preprint-831; ETN-93-92934) Avail: CASI HC A02/MF A01

The cross sections and distributions for the process of positron-electron decays to Z neutral-nu-nu(bar) versus the possible charge conjugation and space inversion (CP) conserving anomalous couplings are studied. An explicit form for the squared matrix element is presented, as well as total cross sections and distributions for several square root of s versus the eta(sub Z) and lambda(sub Z). The total cross section versus eta for lambda = 0 or versus lambda for eta 0 at square root of s = 500 GeV is shown. The effect of the anomalous WWZ couplings on the Z's energy, transverse momentum and rapidity distributions is presented. The bounds on the (eta, lambda) plane are derived. ESA

N93-17343*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SYSTEM MODEL DEVELOPMENT FOR NUCLEAR THERMAL PROPULSION
James T. Walton, Nelson A. Hannan (Argonne National Lab., IL.), Ken R. Perkins (Brookhaven National Lab., Upton, NY.), John J. Buksa (Los Alamos National Lab., NM.), Brian A. Worley (Oak Ridge National Lab., TN.), and Dean Dobranich (Sandia National Labs., Albuquerque, NM.) 1992 12 p Presented at the World Space Congress, Washington, DC, 28 Aug. - 5 Sep. 1992
(Contract DE-AC04-76DP-00789)
(NASA-TM-108215; NAS 1.15:108215; DE92-000754; SAND-92-1820C; IAF-92-0568; CONF-920879-2) Avail: CASI HC A03/MF A01

A critical enabling technology in the evolutionary development of nuclear thermal propulsion (NTP) is the ability to predict the system performance under a variety of operating conditions. Since October 1991, DOE, DOD, and NASA have initiated critical technology development efforts for NTP systems to be used on Space Exploration Initiative (SEI) missions to the Moon and Mars. This paper presents the strategy and progress of an interagency NASA/DOE/DOD team for NTP system modeling. It is the intent of the interagency team to develop several levels of computer programs to simulate various NTP systems. An interagency team was formed for this task to use the best capabilities available and to assure appropriate peer review. The vision and strategy of the interagency team for developing NTP system models are discussed. A review of the progress on the level 1 interagency model is also presented. DOE

N93-17482# Princeton Univ., NJ.
HIGH ENERGY PHYSICS RESEARCH
P. A. Piroue Oct. 1992 22 p
(Contract DE-FG02-91ER-40671)
(DE93-001793; DOE/ER-40671/1) Avail: CASI HC A03/MF A01

The goal of this research is to understand the fundamental constituents of matter and their interactions. At this time, the following activities are

underway: e(+)e(-) interactions and Z(sup 0) physics at CERN; studies to upgrade the L3 detector at LHC; very high statistics charm physics at Fermilab; search for the H particle at BNL; search for the fifth force; rare kaon decay experiments at BNL; study of B-meson physics at hadron colliders; e(+)e(-) pair creation by light at SLAC; R&D related to SSC experiments and the GEM detector; and theoretical research in elementary particle physics and cosmology. The main additions to the activities described in detail in the original grant proposal are the following: (1) an experiment at SLAC (E-144) to study strong-field QED effects in e-laser and gamma-laser collisions; and (2) a search for the H particle at BNL (E-188). The R&D efforts for the GEM detector have also considerably expanded. In this paper we give a brief status report for each activity currently under way. DOE

N93-17580# American Inst. of Physics, New York, NY. Center for History of Physics.
THE STUDY OF MULTI-INSTITUTIONAL COLLABORATIONS IN HIGH-ENERGY PHYSICS
1991 75 p
(Contract DE-FG02-89ER-40516)
(DE93-002337; DOE/ER-40516/2) Avail: CASI HC A04/MF A01

Since World War II, the organizational framework for scientific research is increasingly the multi-institutional collaboration, especially in high-energy physics. A broad preliminary survey, into the functioning of research collaborations involving three or more institutions is described. The study is designed to identify patterns of collaborations, define the scope of the documentation problems, field-test possible solutions, recommend future actions, and build an archives of oral history interviews and other resources for scholarly use. Once the study is completed, its findings will be used to promote systems to document significant collaborative research. DOE

N93-17598# Helsinki Univ. of Technology, Espoo (Finland). Research Inst. for High Energy Physics.
ENERGY MEASUREMENT IN COLLIDER EXPERIMENTS AND SEARCH FOR SCALAR QUARKS IN NEUTRAL Z DEGREE DECAYS AT LEP 1 Ph.D. Thesis
Reino Keranen 1991 71 p Sponsored by Suomen Akatemia and Ministry of Education, Science and Culture
(HU-SEFT-1991-09; ETN-92-92609) Avail: CASI HC A04/MF A01

Research performed during the construction, commissioning, and first year operation of the Detector with Lepton, Photon, and Hadron Identification (DELPHI) Experiment at the Large Electron Positron (LEP1) Storage Ring is reported. The individual contributions described follow the evolution of the experiment. The contributions to hardware, software development, and the final physics analysis are discussed. Special attention is given to topics on techniques of the energy measurement in collider experiments and the search for supersymmetry in elementary particle phenomenology. Motivation for the study was to understand to what extent complete event detection and reconstruction are realized in modern particle experiments. The results from the high statistics LEP data improved the precision of the basic free parameters of the Standard Model, and they have constrained the most popular scenarios of the new physics beyond it. The model is being verified at the level of quantum corrections, thus, conceptually approaching the status of quantum electrodynamics. ESA

N93-17644# Rome Univ. (Italy). Dipartimento di Fisica.
SEARCH FOR pp DECAY TO NEUTRAL H DECAY TO (NEUTRAL Z)(NEUTRAL Z) DECAY TO (mu +)(mu -)(mu +)(mu -) AT THE LHC
Aleandro Nisati (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 18 Jan. 1991 18 p Presented at Large Hadron Collider Workshop, Aachen, Germany, 4-9 Oct. 1990
(Nota-Interna-970; ETN-92-92599) Avail: CASI HC A03/MF A01

The requirements on the lepton momentum resolution in experiments at the Large Hadron Collider (LHC) are analyzed. The detection of the decay of the neutral Higgs boson into four leptons is used as a test bench. The results of the calculation of the main sources of events with at least four muons in the region m(sub 4)mu greater than m sub neutral Z are reported. Different muon momentum resolution effects are discussed. The possibility of using a 'modest' resolution of about 10 together with a simple technique to improve the Higgs mass resolution is reported. ESA

N93-17645# Rome Univ. (Italy). Dipartimento di Fisica.
MUON RATES AT THE LHC
Aleandro Nisati (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 18 Jan. 1991 16 p Presented at Large Hadron Collider Workshop 3, Aachen, Germany, 4-9 Oct. 1990
(Nota-Interna-971; ETN-92-92601) Avail: CASI HC A03/MF A01

The muon production cross sections calculated with the Isajet Monte Carlo generator are reported. The Isajet Monte Carlo incorporates corrections with the parton shower approach. The heavy quarks are fragmented into hadrons using the fragmentation ansatz field and Feynman with the Peterson form. The size of the heavy flavor cross section combined with the luminosity of the Large Hadron Collider (LHC) gives more than 100,000 Hz for the muon transverse momentum greater than 5 GeV/c and more than 1000 Hz for the muon transverse momentum greater than 20 GeV/c. The request of having a rate of the order of 100 Hz for a transverse momentum greater than 50 GeV/c is not possible since much physics is suppressed by such a high cut of the P sub T. By demanding two muons with p sub T above 20 GeV/c, the rate does not exceed 30 Hz and is dominated by Z and heavy quark production. ESA

N93-17706# Cornell Univ., ithaca, NY. Dept. of Electrical Engineering.
NOVEL METHODS OF ACCELERATION Final Report, 30 Sep. 1988 - 29 Jan. 1992
John A. Nation 29 Jan. 1992 28 p
(Grant AF-AFOSR-0328-88)
(AD-A258045; AFOSR-92-0926TR) Avail: CASI HC A03/MF A01

The work summarized in this report covers two research topics. The first deals with a feasibility study of the use of induction linac technology for the production of a multistage proton accelerator, while the second deals with the generation and application of intense microwave radiation signal for use in a compact high average current electron accelerator. The induction linac study was motivated by the objective of obtaining a high current (several kA) deuteron beam of about 3O MeV for neutron production and also to model the late stages of an induction linac system for use in a heavy ion fusion reactor, and the latter study by the possibility of using ultra high power microwave sources developed in our laboratory and elsewhere for the construction of an electron accelerator for use in applications such as FEL drivers. In this report, we summarized both programs. Details of the results obtained may be found in the published papers, copies of which are appended to this report. GRA

N93-16908*# National Aeronautics and Space Administration, Washington, DC.
NUCLEAR ENERGY TECHNOLOGY
David Buden *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 32-56 (For primary document see N93-16905 05-91)
Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N93-15660# Lawrence Livermore National Lab., CA.
EFFECTS OF IONIZING RADIATION ON SELECTED OPTICAL MATERIALS: AN OVERVIEW
G. R. Wirtenson and R. H. White 30 Jul. 1992 9 p
(Contract W-7405-eng-48)
(DE93-001324; UCRL-ID-111453) Avail: CASI HC A02/MF A01

This report gives an overview of the effects of ionizing radiation on optical materials that may be used in spacecraft sensors. It introduces the relevant phenomena and indicates were more detailed information can be found. The topics covered include radiation induced absorption in ultraviolet transmitting materials, ordinary optical glasses, cerium stabilized optical glasses, and infrared transmitting materials; bleaching and annealing, and radioluminesence. DOE

N93-15692*# EIC, Inc., Norwood, MA.
PHOTOELECTROCHEMICAL FABRICATION OF SPECTROSCOPIC DIFFRACTION GRATINGS, PHASE 2 Final Report

R. David Rauh, Michael M. Carrabba, Jianguo Li, Robert F. Cartland, John P. Hachey, and Sam Mathew Feb. 1990 52 p
(Contract NAS5-30086)
(NASA-CR-190875; NAS 1.26:190875) Avail: CASI HC A04/MF A01

This program was directed toward the production of Echelle diffraction gratings by a light-driven, electrochemical etching technique (photoelectrochemical etching). Etching is carried out in single crystal materials, and the differential rate of etching of the different crystallographic planes used to define the groove profiles. Etching of V-groove profiles was first discovered by us during the first phase of this project, which was initially conceived as a general exploration of photoelectrochemical etching techniques for grating fabrication. This highly controllable V-groove etching process was considered to be of high significance for producing low pitch Echelles, and provided the basis for a more extensive Phase 2 investigation. Author

N93-15709# Rome Lab., Griffiss AFB, NY.
THE COMPONENTS OF AN OPTICAL RS FLIP-FLOP FOR AN INTEGRATED OPTICAL PROCESSOR Report, Sep. 1990 - Jan. 1992
Michael A. Parker, Stuart I. Libby, and Paul D. Swanson Jul. 1992 18 p
(AD-A256879; RL-TR-92-87) Avail: CASI HC A03/MF A01

This report discusses the design, fabrication and test of an optical RS Flip-Flop as an integrated optical memory element. The Flip-Flop has three GaAs-AlGaAs heterostructure lasers with total internal reflection mirrors. A main laser incorporates a saturable absorber to develop the bistable output characteristics. A pump laser bleaches the absorber to set the logic 1 state. A third laser quenches the main laser to reset the device to logic 0. Experiments and data for the laser quenching and bistability are presented. GRA

N93-15711*# Dynamics Technology, Inc., Torrance, CA.
FIBER-OPTIC THREE AXIS MAGNETOMETER PROTOTYPE DEVELOPMENT
Thomas D. Wang, David G. McComb, Bradley R. Kingston, C. Michael Dube, Kenneth A. Poehls, and Keith Wanser Oct. 1989 82 p
(Contract NAS7-1001; SBIR-08.10-5433)
(NASA-CR-191882; NAS 1.26:191882; DT-8619-89007) Avail: CASI HC A05/MF A01

The goal of this research program was to develop a high sensitivity, fiber optic, interferometric, three-axis magnetometer for interplanetary spacecraft applications. Dynamics Technology, Inc. (DTI) has successfully integrated a low noise, high bandwidth interferometer with high sensitivity metallic glass transducers. Also, DTI has developed sophisticated signal processing electronics and complete data acquisition, filtering, and display software. The sensor was packaged in a compact, low power and weight unit which facilitates deployment. The magnetic field sensor had subgamma sensitivity and a dynamic range of 10(exp 5) gamma in a 10 Hz bandwidth. Furthermore, the vector instrument exhibited the lowest noise level when only one axis was in operation. A system noise level of 1 gamma rms was observed in a 1 Hz bandwidth. However, with the other two channels operating, the noise level increased by about one order of magnitude. Higher system noise was attributed to cross-channel interference among the dither fields. Author

N93-15846# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
FEATURE EXTRACTION AND CLASSIFICATION OF FLIR IMAGERY USING RELATIVE LOCATIONS OF NON-HOMOGENEOUS REGIONS WITH FEEDFORWARD NEURAL NETWORKS Ph.D. Thesis
Kevin L. Priddy Apr. 1992 119 p
(AD-A256468; AFIT/DS/ENG/92-01) Avail: CASI HC A06/MF A02

The classification of forward looking infrared (FLIR) imagery is explored using Gabor transform decomposition and relative locations of non-homogeneous regions combined with feedforward neural networks. A feature saliency metric is developed from a Bayesian sensitivity analysis of feedforward neural networks. This metric is then used to reduce the dimensionality of the feature vectors used to identify FLIR imagery without any degradation of classification accuracy. Several system architectures are developed using a roving window combined with a series of Gabor filters to produce feature vectors for presentation to a neural network classifier. One architecture uses the Gabor filter coefficients to learn the gestalt of known images. Several of the gestalt networks are then combined to determine the class of an unknown image. Another architecture uses centroid metrics for the cluster of Gabor resonances to feed a backpropagation network acting as a traditional Bayesian classifier. A system architecture is developed which uses the relative locations of texture regions within a user defined template to classify imagery. The relative location architecture is shown to outperform traditional matched filter classifiers. The relative location architecture is shown to be robust in solving the problems presented by crepuscular lighting conditions. GRA

N93-15873# Army Missile Command, Redstone Arsenal, AL. Weapons Science Directorate.
SPATIAL LIGHT MODULATOR NONLINEARITY EFFECTS IN OPTICAL PATTERN RECOGNITION Final Report, Dec. 1990 - Nov. 1991
Tracy D. Hudson Jun. 1992 70 p
(AD-A256184; AD-E951866; AMSMI/TR-RD-WS-92-7) Avail: CASI HC A04/MF A01

Spatial Light Modulators (SLM's) are key elements in real-time optical signal processors. The performance limitations of SLM's have significantly hampered the application of optical pattern recognition systems, such as optical correlators, to Real World problems. Exploration of nonlinear transformations in the Fourier plane of optical processors, such as correlators is of considerable interest. Computer simulations have been extensively reported. Several optically addressed SLM's responses, proposed for use in nonlinear transformation processes, have not been characterized. This report provides experimental data on candidate SLM's: Hughes LCLV, GEC-Marconi SLM, and the University of Colorado-Boulder ferroelectric liquid crystal SLM. Data reported are variations in the driving waveform frequency and amplitude, incident read beam intensity, and spectral variations in the read beam. Equivalent circuit models have been developed to explain modulator response. The nonlinear transformation function of optically addressed SLM's may be used to improve optical processor performance for use as correlators. GRA

N93-16007# Science Applications International Corp., Billerica, MA.
ADAPTIVE MACHINE VISION Final Report, Oct. 1986 - Sep. 1992
A. E. Iverson and William W. Stoner 3 Nov. 1992 20 p
(Contract N00014-86-C-0601)
(AD-A257363) Avail: CASI HC A03/MF A01

A summary is presented on multi-target tracking, adaptive photodetector array concepts for sensors that must operate in nuclear disturbed backgrounds, pattern detection for target/decoy discrimination with a neural network, and Gabor wavelet techniques for feature extraction in a neural network inspired by the Neocognitron of Fukushima. GRA

N93-16079# New Mexico Univ., Albuquerque. Center for High Technology Materials.
OPTOELECTRONIC MATERIALS CENTER: A COLLABORATIVE PROGRAM INCLUDING UNIVERSITY OF NEW MEXICO, STANFORD UNIVERSITY AND CALIFORNIA INSTITUTE OF TECHNOLOGY Quarterly Report, 1 Jan. - Mar. 1992
S. R. Brueck 19 Oct. 1992 12 p
(Contract MDA972-90-C-0046; ARPA Order 7526)
(AD-A257136) Avail: CASI HC A03/MF A01

The Optoelectronic Materials Center is a collaborative program involving the University of New Mexico, Stanford University, and the California Institute of Technology. Sandia National Laboratories and MIT Lincoln Laboratory are also involved in this program under separate contract vehicles. This program emphasizes three main areas: diode-based visible sources, two-dimensional optical interconnects, and high speed optoelectronics. Progress on individual tasks is very briefly discussed below. Several of the tasks will impact more than one of the above areas. For simplicity, the tasks are arranged by institution in an order roughly determined by the above areas. GRA

N93-16102# Lawrence Livermore National Lab., CA.
GEOMETRIC OPTICS SCALING LAWS FOR X-RAY LASER COHERENCE
R. A. London, P. Amendt, and M. Strauss 2 Jul. 1992 6 p Presented at the 3rd International Colloquium on X ray Lasers, Schliersee (Germany), 18-22 May 1992

(Contract W-7405-eng-48)
(DE92-040402; UCRL-JC-111164; CONF-920523-6) Avail: CASI HC A02/MF A01

Analytic scaling laws for the coherence length and coherent power of simple parabolic profile x-ray lasers are derived and applied to estimate the maximum coherent power at saturation and the configuration of such a laser. Approximately 1 mJ of coherent energy at 45 A can be extracted from an ideal single stage laser at saturation, providing an adequate source for application to x-ray holography of biological samples. DOE

N93-16118# Naval Academy, Annapolis, MD.
SYNTHESIS AND CHARACTERIZATION OF DIPOLAR ORGANIC MOLECULES FOR NONLINEAR OPTICAL MATERIALS Final Report, 1991 - 1992
Dennis J. Rivet 8 May 1992 75 p
(AD-A257111; USNA-TSPR-195) Avail: CASI HC A04/MF A01

The object of this investigation is to design, synthesize, and characterize novel organic materials for efficient second-harmonic generation. Second-harmonic generation is a nonlinear optical phenomenon that can be observed for a variety of inorganic and organic materials, some of which have been incorporated into electrical devices to perform various operations. While most devices at the present time utilize inorganic compounds, the search for highly efficient and easily processable materials has led to the investigation of various classes of organic compounds. In this project, the synthesis of three general classes of molecules was attempted: (1) amphiphilix azo dyes, (2) polymeric p-(dialkyamino)arylamines, and (3) poly(pyridinevinylene). These molecules appear to possess the electronic and structural properties necessary for efficient second-harmonic generation. GRA

N93-16120# Naval Academy, Annapolis, MD.
STEREO VISION CONTROLLED BILATERAL TELEROBOTIC REMOTE ASSEMBLY STATION Final Report, 1991 - 1992
Robert L. Dewitt 8 May 1992 66 p
(AD-A257113; USNA-TSPR-187) Avail: CASI HC A04/MF A01

The objective of this project was to develop a bilateral six degree-of-freedom telerobotic component assembly station utilizing remote stereo vision assisted control. The component assembly station consists of two Unimation Puma 260 robot arms and their associated controls, two Panasonic miniature camera systems, and an air compressor. The operator controls the assembly station remotely via kinematically similar master controllers. A Zenith 386 personal computer acts as an interface and system control between the human operator's controls and the Val II computer controlling the arms. A series of tasks, ranging in complexity and difficulty, was utilized to assess and demonstrate the performance of the complete system. GRA

N93-16127# Department of the Navy, Washington, DC.
HETERODYNE ARRAY FOR MEASUREMENT OF TARGET VELOCITY Patent Application
Marc D. Mermelstein, inventor (to Navy) 30 Jun. 1992 36 p
(AD-D015402; US-Patent-Appl-SN-906649) Avail: CASI HC A03/MF A01

This is a system for determining the angular velocity of a mobile target relative to a station. The system develops first and second reference beams and a beam to the target to enable the target to generate first and second signals. Optical devices, preferably fiber optical devices, responsive to the first and second reference beams and to the first and second signals respectively received from the target at discrete first and second positions on the station, respectively produce first and second interference pattern signals. Each of the received signals has a Doppler shift as a function of the movement of the target. An electrical processing circuit then processes the interference pattern signals to develop a signal indicative of the target's angular velocity. GRA

N93-16196# California Univ., Berkeley. Lawrence Berkeley Lab.
ADVANCED LIGHT SOURCE Scientific Program, 1993-1994
Aug. 1992 35 p
(Contract DE-AC03-76SF-00098)
(DE92-041181; LBL-Pub-706) Avail: CASI HC A03/MF A01

This composite document outlines ten different experiments planned for the beamline at the Advanced Light Source. Researchers from various parts of the country have detailed their methods and equipment to be used in experiments in biology and physics. X-ray spectroscopy and microscopy are the common topics to these experiments. DOE

N93-16231# Sandia National Labs., Albuquerque, NM.
DIELECTRIC OPTICAL WAVEGUIDE SENSORS INTEGRATED WITH GaAs ACTIVE DEVICES
R. F. Carson, S. A. Casalnuovo, and M. B. Sinclair 1992 11 p
Presented at the The International Society for Optical Engineering (SPIE) Meeting, Boston, MA, 8-11 Sep. 1992
(Contract DE-AC04-76DP-00789)
(DE93-000750; SAND-92-0651C; CONF-9209184-3) Avail: CASI HC A03/MF A01

Dielectric optical waveguides exhibit properties that are well suited to sensor applications. They have low refractive index and are transparent to a wide range of wavelengths. They can react with the surrounding environment in a variety of controllable ways. In certain sensor applications, its is advantageous to integrate the dielectric waveguide on a semiconductor substrate with active devices. In this work, we demonstrate a tamper sensor based on dielectric waveguides that connect epitaxial GaAs-GaAlAs sources and detectors. The tamper sensing function is by attaching particles of absorbing material with high refractive index to the surface of the waveguides. These absorbers are then attached to a lid or cover, as in an integrated circuit package or multi-chip module. The absorbers attenuate the light in the waveguides as a function of absorber interaction. The absorbers are placed randomly on the waveguides, to form a unique attenuation pattern that is registered by the relative signal levels on the photodetectors. When the lid is moved, the pattern of absorbers changes, altering the photodetector signals. The dielectric waveguide arrangement is applicable to a variety of sensor functions, and can make use of resonant coupling properties between low refractive index dielectric waveguides and high-index absorbing materials. DOE

N93-16235# Michigan Univ., Ann Arbor.
NONLINEAR OPTICAL STUDIES OF RESONANT SYSTEMS Final Report, 1 May 1989 - 1 Jun. 1992
Duncan G. Steel Aug. 1992 219 p
(Contract DAAL03-89-K-0099)
(AD-A257001; ARO-26644.19-PH) Avail: CASI HC A10/MF A03

Work has concentrated on the development of high resolution frequency domain nonlinear spectroscopy methods as well as the use of picosecond coherent techniques such as the stimulated photon echo and time resolved free polarization decay. Using these methods, new understanding has been obtained on the dynamics associated with excitons in GaAs/AlGaAs quantum well structures, particularly as these dynamics are affected by disorder. GRA

N93-16261# United Technologies Research Center, East Hartford, CT.
HACT SPATIAL LIGHT MODULATOR Final Report, 1 Apr. 1991 - 30 Apr. 1992
Thomas W. Grudkowski and Faquir C. Jain Sep. 1992 49 p
(Contract N00014-91-C-0090)
(AD-A256994; UTC-R92-970069-F) Avail: CASI HC A03/MF A01

High contrast ratio exceeding 1200:1 has been obtained in Fabry-Perot structures consisting of InGaAs-GaAs multiple quantum well layers and AlAs-GaAs dielectric mirrors on GaAs substrates. The tuning voltage ranges between 5 to 25 volts, and the wavelength shifts between 4 to 10 nm. The on-loss is about 5 dB. The design of couples-cavity Fabry-Perot structures were completed to obtain a contrast of over 6000:1, and the fabrication is in progress. These structures are designed to yield lower on-loss along with a wider transmission spectrum of greater than 1 nm. Heterojunction Acoustic Charge Transport (HACT) devices were fabricated in various formats including freeze frame features. The HACT device is a type of CCD which uses a surface acoustic wave to propagate charge along an AlGaAs/GaAs heterostructure. It provides a method of addressing the SLM array without using multiple interconnect circuits. GRA

N93-16437# Department of the Navy, Washington, DC.
ARMORED FIBER OPTIC CABLES STATEMENT OF GOVERNMENT INTEREST Patent Application
Gerald Holmberg, inventor (to Navy) 10 Jun. 1992 10 p

(AD-D015459; US-Patent-Appl-SN-896633; Navy-Case-72277) Avail: CASI HC A02/MF A01

An armored fiber optic cable is disclosed having both fiber optics and armor wires located outside the cable core in position where the fiber optics experience low strain when the cable is under stress. In one embodiment, metal armor wires and optical fibers embedded in metal tubes are arrayed in one or more layers about and outside the cable core. In another embodiment, KEVLAR armor wires and optical fibers embedded within a hard composite shell are arrayed in one or more layers about and outside the cable core, and a layer of KEVLAR armor is provided surrounding the one or more layers. In each of the embodiments the strains that the fiber optics experience due to core stresses and due to core residual strain is materially reduced over the heretofore known armored fiber optic cables. GRA

N93-16456 Department of the Navy, Washington, DC.
HIGH-STRENGTH IN-LINE FIBER OPTIC CONNECTOR Patent
Roger L. Morency, inventor (to Navy) and Gregory H. Ames, inventor (to Navy) 19 May 1992 5 p Filed 26 Apr. 1991
(AD-D015446; US-Patent-5,115,483; US-Patent-Appl-SN-691767; US-Patent-Class-385-60) Avail: US Patent and Trademark Office

An in-line fiber optic connector has a pair of ferruled components having ferrules enclosing optical fibers. The optical fibers are connected by placing the faces of said ferrules in abutment with each other inside a split tube. Threaded components that abut the ferruled components bring the faces of the ferrules together by being threaded to each other. This enables the compression between the faces of the ferrules to be closely controlled. GRA

N93-16480 Department of the Navy, Washington, DC.
POLARIZATION INDEPENDENT NARROW CHANNEL WAVELENGTH DIVISION MULTIPLEXING FIBER COUPLER AND METHOD FOR PRODUCING SAME Patent
Richard J. Orazi, inventor (to NAvy) and Matthew N. McLandrich, inventor (to Navy) 9 Jun. 1992 13 p Filed 12 Jun. 1991
(AD-D015473; US-Patent-5,121,453; US-Patent-Appl-SN-718317; US-Patent-Class-385-51) Avail: US Patent and Trademark Office

The invention provides a method for fabricating a polarization independent narrow channel wavelength division multiplexing fiber optic coupler, comprising the following steps: holding two optical fibers in an abutting longitudinal relation along a predetermined length of the fibers; injecting light energy into one of the fibers; fusing the optical fibers together along the predetermined length to form a fused length of a fiber optic coupler; elongating the fused length of the fusing optical fibers; measuring the light energy output from the ends of the first and second fibers; ceasing the fusing and elongating when the measured light energy output from the ends of the first and second fibers indicates that a predetermined number, Ns, of one-half power transfer cycles have occurred in the coupler, where the Nsth one-half power transfer cycle occurs within a K pi phase region of a polarization envelope associated with the coupler, where K is a positive integer. GRA

N93-16481 Department of the Navy, Washington, DC.
GRID FREE, MODULAR, LARGE SCREEN DISPLAY Patent
Parviz Soltan, inventor (to Navy) 7 Jul. 1992 9 p Filed 1 Nov. 1990
(AD-D015474; US-Patent-5,129,028; US-Patent-Appl-SN-608135; US-Patent-Class-385-120) Avail: US Patent and Trademark Office

An improvement for a large screen display eliminates the gap/grid line which is otherwise present between abutted display modules. Each of the display modules has a light emanating/reflecting display surface which provides a visual indication of the information content on a problem of a visual display for the large screen. A diverging strip is superimposed over each gap/grid line and at least a portion of the butting light-radiating display surfaces so that light is diverged from the abutted light-radiating surfaces to optically mask the gap/grid line and present a continuous uninterrupted display across the surface of the large screen display. The diverging strip can be tilted hollow fiber microchannels, tilted optical fibers or tilted plastic fibers inclined or fan-shaped at about a 10-15 deg angle so that the gap/grip lines are optically masked. Optionally, a diverger panel as big as the display module is superimposed over each module extending over the gap/grid line for diverging the light projected from the abutted light radiating panels, thereby optically masking each gap/grid line. A linear face plate is mounted on the strip to improve the viewing angle. GRA

N93-16495 Department of the Navy, Washington, DC.
OPTICAL SYSTEM FOR LINEARIZING NON-LINEAR ELECTRO-OPTIC Patent
J. K. Pillow, inventor (to Navy) 28 Jul. 1992 5 p Filed 19 Feb. 1991
(AD-D015496; US-Patent-5,134,361; US-Patent-Appl-SN-657015) Avail: US Patent and Trademark Office

A device for rapidly measuring voltages by electro-optic or magneto-optic means exhibits a substantially linear response over much of its operating range. The device employs the Pockels effect in which the orientation of polarized light is altered in direct response to applied voltages. The response of the subject device is made substantially more linear by dividing the polarized light into two beams and retarding the phase of the second beam by one-quarter wavelength, attenuating its intensity by a factor of approximately four, and passing it through a second Pockels cell having a transducer constant of one half that of the first Pockels cell and then recombining, or superpositioning, the first and second beams of light, thus yielding a substantially linear response over much of the applied voltage range. GRA

N93-16542# Aerospace Corp., El Segundo, CA. Target Signatures and Backgrounds Dept.
EXACT CALCULATION OF LIGHT SCATTERING FROM A PARTICLE ON A MIRROR
B. R. Johnson 15 Nov. 1992 23 p
(ATR-92(8476)-1) Avail: CASI HC A03/MF A01

Exact methods have been developed for calculating light scattering from particles on a perfectly reflecting surface. The computed solutions obey Maxwell's equations and the appropriate boundary conditions. A brief discussion of the theory is followed by a presentation and discussion of selected scattering results. Comparisons are made with the predictions of Young's forward scatter Mie theory model. Under certain conditions the exact results differ significantly from Mie theory. The exact differential cross sections exhibit large amplitude oscillations that are not predicted by Mie theory. The bidirectional reflectance distribution function (BRDF) is also calculated using exact scattering theory for both spherical and hemispherical particles that are both absorptive (complex index of refraction) and nonabsorptive (real index of refraction). These exact BRDF results are compared to the predictions of Young's model. Author

N93-16712*# Advanced Technologies, Inc., Tucson, AZ.
ADVANCED IMAGING SYSTEM Final Report
31 Dec. 1992 415 p
(Contract NAS5-30171; SBIR-08.01-8961)
(NASA-CR-191800; NAS 1.26:191800) Avail: CASI HC A18/MF A04

This document describes the Advanced Imaging System CCD based camera. The AIS1 camera system was developed at Photometric Ltd. in Tucson, Arizona as part of a Phase 2 SBIR contract No. NAS5-30171 from the NASA/Goddard Space Flight Center in Greenbelt, Maryland. The camera project was undertaken as a part of the Space Telescope Imaging Spectrograph (STIS) project. This document is intended to serve as a complete manual for the use and maintenance of the camera system. All the different parts of the camera hardware and software are discussed and complete schematics and source code listings are provided. Author

N93-16928# Sandia National Labs., Albuquerque, NM.
ELECTROOPTIC PROPERTIES OF PZT THIN FILMS FOR IMAGE STORAGE APPLICATIONS
D. Dimos and R. W. Schwartz 1992 7 p Presented at the Material Research Society Symposium, Boston, MA, 2-6 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE92-008523; SAND-91-2901C; CONF-921206-2) Avail: CASI HC A02/MF A01

The photocurrent response, photo-induced changes in hysteresis behavior, and electrooptic (birefringence) effects of sol-gel derived PZT film have been characterized as part of an effort to evaluate ferroelectric films for image storage and processing applications. DOE

N93-16982# Rome Univ. (Italy). Dipt. di Fisica.
SELF-SIMILARITY IN STIMULATED RAMAN SCATTERING
D. Levi (Maryland Univ., Baltimore.), C. R. Menyuk, and P. Winternitz (Montreal Univ., Quebec) 8 Apr. 1992 15 p Submitted for publication Sponsored in part by NRL; Canadian Natural Sciences and Engineering Research Council; FCAR; Istituto Nazionale di Fisica Nucleare; and NATO
(Grant NSF ECS-91-14191)
(Preprint-878; ETN-93-92978) Avail: CASI HC A03/MF A01

The transient stimulated Raman scattering is discussed. The equations which govern stimulated Raman scattering in the transient limit are integrable. In contrast, solitons are transient and the behavior of the system at long distances is dominated by self similar solutions which may be found by symmetry reduction. Rules to determine the self similar solution, toward which a system tends to, are given. Numerical results indicating the correctness of the rules are included. An experiment to verify theoretical predictions is presented. It is shown for general initial conditions precisely which self similar solution the system tends toward at long distances. It is argued that this behavior, in which self similar solutions dominate the long distance evolution, should appear in nonlinear optical systems with memory. ESA

N93-17052*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN INTERFEROMETER HAVING FUSED OPTICAL FIBERS, AND APPARATUS AND METHOD USING THE INTERFEROMETER Patent Application
Richard F. Hellbaum, inventor (to NASA), Richard O. Claus, inventor (to NASA), Kent A. Murphy, inventor (to NASA), and Michael F. Gunther, inventor (to NASA) 1 Oct. 1992 25 p
(NASA-Case-LAR-14640-1-CU; NAS 1.71:LAR-14640-1-CU; US-Patent-Appl-SN-956685) Avail: CASI HC A03/MF A01

An interferometer includes a first optical fiber coupled to a second optical fiber by fusing. At a fused portion, the first and second optical fibers are cut to expose respective cores. The cut or fused end of the first and second optical fibers is arranged to oppose a diaphragm or surface against which a physical phenomenon such as pressure or stress, is applied. In a first embodiment, a source light which is generally single-mode monochromatic, coherent light, is input to the first optical fiber and by evanescence, effectively crosses to the second optical fiber at the fused portion. Source light from the second optical fiber is reflected by the diaphragm or surface, and received at the second optical fiber to generate an output light which has an intensity which depends upon interference of reference light based on the source light, and the reflected light reflected from the diaphragm or surface. The intensity of the output light represents a positional relationship or displacement between the interferometer and the diaphragm or surface. NASA

N93-17176# Argonne National Lab., IL.
HARD X RAY MICROIMAGING TECHNIQUES BASED ON PHASE ZONE PLATES
B. Lai, W. B. Yun, D. Legnini, Y. H. Xiao, and J. Chrzas 1992 6 p Presented at the Society of Photo-Optical Instrumentation Engineers International Symposium on Optical Applied Science and Engineering, San Diego, CA, 19-24 Jul. 1992
(Contract W-31-109-eng-38)
(DE93-000615; ANL/CP-77398; CONF-920792-33) Avail: CASI HC A02/MF A01

Phase zone plates of high focusing efficiency and submicron resolution have been demonstrated in the hard x-ray region. A scanning microscope based on these focusing optics will create many new applications. Preliminary results in the applications of the microscope are reported. In the area of imaging, we have utilized absorption contrast to clearly identify the locations of Au and Ni constituents in a sample of two interleaved grids. Micro-EXAFS spectra has also been obtained on a Ni foil. Fluorescence from a nuclear fuel sample, as an example of microanalysis, has revealed the elemental distribution at the interfaces. Lastly, microdiffraction from AgBr crystallites was studied. DOE

N93-17225# Lawrence Livermore National Lab., CA.
DUAL-BAND INFRARED IMAGING APPLICATIONS: LOCATING BURIED MINEFIELDS, MAPPING SEA ICE, AND INSPECTING AGING AIRCRAFT
N. K. DelGrande, P. F. Durbin, and D. E. Perkins Sep. 1992 8 p Presented at the Quantitative Nondestructive Evaluation Conference, San Diego, CA, 19-24 Jul. 1992
(Contract W-7405-eng-48)
(DE93-000516; UCRL-JC-111214; CONF-9207155-1) Avail: CASI HC A02/MF A01

We discuss the use of dual-band infrared (DBIR) imaging for three quantitative NDE applications: location buried surrogate mines, mapping sea ice thicknesses, and inspecting subsurface flaws in aging aircraft parts. Our system of DBIR imaging offers a unique combination of thermal resolution, detectability, and interpretability. Pioneered at Lawrence Livermore Laboratory, it resolves 0.2 C differences in surface temperatures needed to identify buried mine sites and distinguish them from surface features. It produces both surface temperature and emissivity-ratio images of sea ice, needed to accurately map ice thicknesses (e.g., by first removing clutter due to snow and surface roughness effects). The DBIR imaging technique depicts subsurface flaws in composite patches and lap joints of aircraft, thus providing a needed tool for aging aircraft inspections. DOE

N93-17273*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OPERATOR-TAILORED ADJUSTABLE CONTROL STATION WITH MOVABLE MONITORS AND CAMERAS FOR VIEWING SYSTEMS IN ROBOTICS AND TELEOPERATIONS Patent Application
Daniel B. Diner, inventor (to NASA) 28 Sep. 1992 33 p
(NASA-Case-NPO-17837-1-CU; NAS 1.71:NPO-17837-1-CU; US-Patent-Appl-SN-954109) Avail: CASI HC A03/MF A01

Real-time video presentations are provided in the field of operator-supervised automation and teleoperation, particularly in control stations having movable cameras for optimal viewing of a region of interest in robotics and teleoperations for performing different types of tasks. Movable monitors to match the corresponding camera orientations (pan, tilt, and roll) are provided in order to match the coordinate systems of all the monitors to the operator internal coordinate system. Automated control of the arrangement of cameras and monitors, and of the configuration of system parameters, is provided for optimal viewing and performance of each type of task for each operator since operators have different individual characteristics. The optimal viewing arrangement and system parameter configuration is determined and stored for each operator in performing each of many types of tasks in order to aid the automation of setting up optimal arrangements and configurations for successive tasks in real time. Factors in determining what is optimal include the operator's ability to use hand-controllers for each type of task. Robot joint locations, forces and torques are used, as well as the operator's identity, to identify the current type of task being performed in order to call up a stored optimal viewing arrangement and system parameter configuration. NASA

N93-17406# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
MULTISENSOR PERCEPTION AND SCENE INTERPRETATION Ph.D. Thesis - Toulouse Univ.
Pierrick Grandjean 1991 185 p In FRENCH
(LAAS-91305; ETN-92-92546) Avail: CASI HC A09/MF A02

The problem of scene interpretation by a multisensor perception machine is considered. Interpreting means representing the environment by a set of geometric primitives (three dimensional modeling) and object models (recognition). Both accuracy and reliability can be improved by using multiple and/or different sensors. A synthetic approach for modeling the sensor abilities and the structure of a multisensor system is proposed, and a generic technique for numeric fusion, based on probabilistic representation of primitive accuracy, is presented. On the basis of these concepts and techniques, a three dimensional polyhedral modeling system and a generic multisensor system for three dimensional object recognition were developed. The latter relies on the hypothesize and test paradigm and uses declarative object and sensor models that were previously compiled into specific knowledge structures. It is validated by experimental results in real environments, with real life objects (pieces of furniture) in cluttered scenes. The experimental set up is composed of the three dimensional modeling system, a stereovision system, and several black and white and color cameras. The problem of estimating the confidence of multisensory interpretation hypotheses is analyzed and it appears to be made of two complementary notions: similarity and ambiguity. An approach is developed, in a Bayesian framework, that relies on an experimental determination of

the sensor data ambiguity. This work enables one to tackle the problems of controlling the algorithm and choosing the sensor to use, that become central issues in a multisensor system. This system is part of the experimental demonstrator of the Esprit Project, SKIDS. Some of its other interpretation functionalities are presented: consistency maintenance and perception planning. ESA

N93-17581# National Aerospace Lab., Amsterdam (Netherlands). Space Div.

A STUDY ON FOCUSING IN TELESCIENCE USING THE TELEPODI BREADBOARD

C. L. Pinches (Imperial Coll. of Science and Technology, London England), E. A. Kuijpers, and F. Spaan 25 Jan. 1991 52 p

(Contract NIVR-02607-N)

(NLR-TP-91036-U; ETN-92-92513) Copyright Avail: CASI HC A04/MF A01

Research was conducted using the Prototype Optical Diagnostic Instrument (PODI). This breadboard was extended to TelePODI (Teleoperated PODI) to allow for the study of telescience and image processing for microgravity related instrumentation. Microgravity experiments operated using telescience concepts face certain constraints. The effect of the constraints on the focusing task are identified. Four types of focusing strategies, which provide a natural means of focusing in the presence of these constraints, are described. Three specific strategies are implemented as part of the teleoperated prototype optical diagnostic instrument breadboard using a task dependent man machine interface. Evaluation of these strategies is based on considerations of accuracy of focus, working range and human factors issues. ESA

N93-17642# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

ENHANCED POLARIZATION-DEPENDENT COUPLING BETWEEN AN OPTICAL WAVEGUIDE AND LATERALLY COUPLED PHOTODETECTOR

Konrad Kapser and Peter P. Deimel 1991 5 p Repr. from J. Appl. Phys., v. 70, no. 1, 1 Jul. 1991 p 13-16 Sponsored by BMFT

(MBB-Z-0338-90-PUB; ETN-92-92744) Avail: CASI HC A01/MF A01

Parameters for an optimal matching layer between a waveguide and a laterally coupled photodetector for transverse electric (TE) and transverse magnetic (TM) modes were calculated. A difference was found in the order of a few percent between the classical and exact calculations based on optical models concerning the optimal matching layer thickness. Also, the thickness of the matching layer depends critically on the thickness of the absorbing layer. Comparing TE and TM modes, the absorption maxima for TE(TM) and the minima for TM(TE) coincide approximately, and the maxima and minima depend on the matching layer thickness. ESA

N93-17691# SRI International Corp., Menlo Park, CA.

IR MATERIALS PRODUCIBILITY Quarterly Report No. 1, 12 Aug. - 31 Oct. 1992

A. Sher, M. A. Berding, A. B. Chen, and M. Muller Nov. 1992 33 p

(Contract MDA972-92-C-0053; ARPA Order 8557)

(AD-A257695) Avail: CASI HC A03/MF A01

We have included the gradient correction to the local density approximation, and used it to calculate the cohesive energies for HgTe, CdTe, ZnTe, and ZnSe. We find excellent agreement with experiment. The gradient correction was also added to the defect formation energies in HgTe (used as a model for HgCdTe). Again, the calculated defect densities are in very good agreement with experiment. We have also examined the band structure of HgCdTe and find it to be highly nonparabolic; we have begun to explore the consequences on the defect densities and other device properties. We have examined the properties of dislocations in HgCdTe and conclude that the trapping of carriers at localized states at the dislocation core is not responsible for the observed effects of dislocations on devices. We are currently examining the effect of dislocation-related strain fields on the piezoelectric HgCdTe and their consequences on device properties. We have begun to calculate the defect formation energies in ZnSe, including relaxation of the nearest neighbors. GRA

N93-17702# Manchester Univ. (England). Inst. of Science and Technology.

MOLECULAR FILMS FOR OPTO-ELECTRONICS Final Report, 1 Oct. 1989 - 30 Jun. 1992

J. O. Williams 24 Sep. 1992 43 p

(Contract DAJA45-89-C-0036)

(AD-A258070) Avail: CASI HC A03/MF A01

Molecular dynamics computer simulations have been used to model monolayer and trilayer Langmuir-Blodgett films formed by model amphiphilic molecules. Several factors have been identified that control film structure and stability, thus giving insight into optimum molecular design. Head-groups and the substituent position of hydrocarbon chains should be designed to maximize the stability of layer-like packing. Molecular tilt is an important factor since it results in local structural defects and roughening of interfaces which could lead to formation of long range inhomogeneities. Numerical calculations of non-linear optical response have been performed for model LB films in which molecules are treated as rigid strings of beads to represent their size, shape and orientation. Interactions between molecules are obtained as planewise dipole sums which prove to be negligible except within a layer. GRA

N93-17748# Massachusetts Inst. of Tech., Cambridge.

PHOTOREFRACTIVE PROPERTIES OF DOPED BaTiO 3 AND SBN Final Report, Feb. 1986 - May 1992

Cardinal Warde Dec. 1991 88 p

(Contract F19628-85-K-0050; DARPA Order 5397)

(AD-A257989; RL-TR-91-382) Avail: CASI HC A05/MF A01

Several novel photorefractive scattering processes were studied. Isotropic scattering of a single intense pump beam was observed and modeled. Numerical calculations, performed using material parameters consistent with the previous experiments, yielded scattering cross sections in excellent agreement with the observations. Anisotropic scattering of a single extraordinary polarized beam into conical rings of light was also observed. Using a phase matching condition and the electrooptic tensor symmetry properties of BaTiO3, the scattering process of the inner ring was uniquely determined. A model which describes the formation of the outer ring was also proposed. GRA

N93-17796# Naval Postgraduate School, Monterey, CA.

MICROCOMPUTER SIMULATION OF A FOURIER APPROACH TO OPTICAL WAVE PROPAGATION M.S. Thesis

John G. Upton Jun. 1992 114 p

(AD-A257598) Avail: CASI HC A06/MF A02

This thesis uses spatial impulse response theory adapted from continuous-wave Fourier diffraction theory as the basis for a microcomputer program to model pulsed optical wave propagation. Programs to generate uniform circular and uniform square excitation functions are included, along with examples of the spatial impulse response for each. Additionally, two new excitation functions with circular Gaussian and circular Bessel spatial distributions are modelled for use in future research. All programs have been written using the MATLAB software package. This effort provides a means to analyze the transient optical wave propagation of a spatially filtered optical source. GRA

N93-17307*# Alabama Univ., Huntsville. Dept. of Electrical Engineering.

ADAPTIVE OPTICS FOR LASER POWER BEAMING

Robert P. Leland *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

N93-17449*# BRW, Inc., Minneapolis, MN.

EXTRATERRESTRIAL APPLICATIONS OF SOLAR OPTICS FOR INTERIOR ILLUMINATION

David A. Eijadi and Kyle D. Williams *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 299-303 Previously announced in IAA as A89-45749 (For primary document see N93-17414 05-91)

Avail: CASI HC A01/MF A03

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N93-15666# TRW Systems and Energy, Redondo Beach, CA. Applied Technology Div.

MHD INTEGRATED TOPPING CYCLE PROJECT

Jul. 1992 71 p

(Contract DE-AC22-87PC-90274)

(DE92-041285; DOE/PC-90274/T19; MHD-ITC-92-168) Avail: CASI HC A04/MF A01

This eighteenth quarterly technical progress report of the MHD Integrated Topping cycle Project presents the accomplishments during the period November 1, 1991 to January 31, 1992. The precombustor is fully assembled. Manufacturing of all slagging stage components has been completed. All cooling panels were welded in place and the panel/shell gap was filled with RTV. Final combustor assembly is in progress. The low pressure cooling subsystem (LPCS) was delivered to the CDIF. Second stage brazing issues were resolved. The construction of the two anode power cabinets was completed. DOE

N93-15670# Texas Univ., Austin. Inst. for Fusion Studies.

PARTICLE SIMULATION ALGORITHMS WITH SHORT-RANGE FORCES IN MHD AND FLUID FLOW

S. Cable, T. Tajima, and K. Umegaki Jul. 1992 17 p

(Contract DE-FG05-80ET-53088)

(DE93-000407; DOE/ET-53088/564; IFSR-564) Avail: CASI HC A03/MF A01

Attempts are made to develop numerical algorithms for handling fluid flows involving liquids and liquid-gas mixtures. In these types of systems, the short-range intermolecular interactions are important enough to significantly alter behavior predicted on the basis of standard fluid mechanics and magnetohydrodynamics alone. We have constructed a particle-in-cell (PIC) code for the purpose of studying the effects of these interactions. Of the algorithms considered, the one which has been successfully implemented is based on a MHD particle code developed by Brunel et al. In the version presented here, short range forces are included in particle motion by, first, calculating the forces between individual particles and then, to prevent aliasing, interpolating these forces to the computational grid points, then interpolating the forces back to the particles. The code has been used to model a simple two-fluid Rayleigh-Taylor instability. Limitations to the accuracy of the code exist at short wavelengths, where the effects of the short-range forces would be expected to be most pronounced. DOE

N93-15672# Texas Univ., Austin. Inst. for Fusion Studies.

TOROIDAL EFFECTS ON DRIFT WAVE TURBULENCE

M. J. LeBrun, T. Tajima, M. G. Gray, G. Furnish, and W. Horton 23 Sep. 1992 77 p

(Contract DE-FG05-80ET-53088)

(DE93-000498; DOE/ET-53088/563; IFSR-563) Avail: CASI HC A05/MF A01

The universal drift instability and other drift instabilities driven by density and temperature gradients in a toroidal system are investigated in both linear and nonlinear regimes via particle simulation. Runs in toroidal and cylindrical geometry show dramatic differences in plasma behavior, primarily due to the toroidicity-induced coupling of rational surfaces through the poloidal mode number m. In the toroidal system studied, the eigenmodes are seen to possess (1) an elongated, nearly global radial extent (2) a higher growth rate than in the corresponding cylindrical system, (3) an eigenfrequency nearly constant with radius, (4) a global temperature relaxation and enhancement of thermal heat conduction. Most importantly, the measured Xi shows an increase with radius and an absolute value on the order of that observed in experiment. On the basis of our observations, we argue that the increase in Xi with radius observed in experiment is caused by the global nature of heat convection in the presence of toroidicity-induced mode coupling. DOE

N93-15678# TRW Space Technology Labs., Redondo Beach, CA. Applied Technology Div.

MHD INTEGRATED TOPPING CYCLE PROJECT

Jul. 1992 83 p

(Contract DE-AC22-87PC-90274)

(DE92-041284; DOE/PC-90274/T20; MHD-ITC-92-126) Avail: CASI HC A05/MF A01

This seventeenth quarterly technical progress report of the MHD Integrated Topping Cycle Project presents the accomplishments during the period August 1, 1991 to October 31, 1991. Manufacturing of the prototypical combustor pressure shell has been completed including leak, proof, and assembly fit checking. Manufacturing of forty-five cooling panels was also completed including leak, proof, and flow testing. All precombustor internal components (combustion can baffle and swirl box) were received and checked, and integration of the components was initiated. A decision was made regarding the primary and backup designs for the 1A4 channel. The assembly of the channel related prototypical hardware continued. The cathode wall electrical wiring is now complete. The mechanical design of the diffuser has been completed. DOE

N93-15697# Science Applications International Corp., San Diego, CA.

SALIENT ISSUES OF EDGE PHYSICS PERTAINING TO LOSS OF CONFINEMENT: A RESISTIVE MHD ANALYSIS

D. R. Thayer 1991 7 p

(Contract DE-FG03-90ER-54071)

(DE93-000600; DOE/ER-54071/T2) Avail: CASI HC A02/MF A01

The progress that has been made during this fiscal year is significant in the area of tokamak edge plasma transport. The drift-rippling mode model of edge turbulent transport was extended. In particular, the research areas on which they were concentrated include the following topics: (1) The theoretical investigation of the radiatively enhanced transport due to the effects of impurity driven radiation instabilities has been expanded to include a situation with multiple impurities (such as carbon, C(sup 4+), and oxygen, O(sup 6+)); (2) In order to validate the use of the impurity radiation input from the tokamak bolometer experiments in the theoretical edge turbulent transport calculations, the analysis that is utilized to transform impurity brightness data to radiated power profiles has been checked for state population and Abel inversion correctness; (3) The drift-rippling model of edge turbulent transport has been extended to include ionization particle sources in addition to the impurity driven thermal instability drive; and (4) The detailed limiter and realistic edge geometric effects on the edge turbulent transport has been included in the drift-rippling model. DOE

N93-15827# General Atomic Co., San Diego, CA.

PHYSICS OF THE L-MODE TO H-MODE TRANSITION IN TOKAMAKS

K. H. Burrell, T. N. Carlstrom, P. Gohil, R. J. Groebner, J. Kim, T. H. Osborne, H. St.John, R. D. Stambaugh, E. J. Doyle, and R. A. Moyer et al Jul. 1992 11 p Presented at the 14th International Conference on Plasma and 19th EPS Conference on Controlled Fusion and Plasma Physics, Innsbruck (Austria), 29 Jun. - 3 Jul. 1992

(Contract DE-AC03-89ER-51114)

(DE92-040697; GA-A-20993; CONF-920610-14) Avail: CASI HC A03/MF A01

Combined theoretical and experimental work has resulted in the creation of a paradigm which has allowed semi-quantitative understanding of the edge confinement improvement that occurs in the H-mode. Shear in the E x B flow of the fluctuations in the plasma edge can lead to decorrelation of the fluctuations, decreased radial correlation lengths and reduced turbulent transport. Changes in the radial electric field, the density fluctuations, and the edge transport consistent with shear stabilization of turbulence were seen in several tokamaks. The purpose of this paper is to discuss the most recent data in the light of the basic paradigm of electric field shear stabilization and to critically compare the experimental results with various theories. DOE

N93-15849# Los Alamos National Lab., NM.

RECENT DIAGNOSTIC DEVELOPMENT FOR THE LOS ALAMOS INERTIAL FUSION PROGRAM

J. M. Mack, R. E. Chrien, and J. A. Oertel 1992 10 p Presented at the 14th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Wuerzburg, Germany, 30 Sep. - 7 Oct. 1992

(Contract W-7405-eng-36)

(DE92-040362; LA-UR-92-2854; IAEA-CN-56/B-1-5-2(R); CONF-920913-12) Avail: CASI HC A02/MF A01

Diagnostics for indirect-drive inertial confinement fusion (ICF) require

significant advances in time, space, and energy resolution. We report on two new diagnostics meant for permanent operation on the Nova Laser Facility: (1) a multiframe gated x-ray camera for acquiring highly time-resolved two-dimensional target images; and (2) an ion temperature diagnostic based on a single-hit neutron time-of-flight measurements for study of implosion dynamics for d-d and d-t fusion targets. DOE

N93-15922# Maryland Univ., College Park. Lab. for Plasma Research.
MEASUREMENT OF IMPURITY ION DENSITIES AND ENERGIES IN THE DIVERTOR AND EDGE REGIONS OF ALCATOR C-MOD TOKAMAK
H. R. Griem, J. Moreno, and B. L. Welch 1992 6 p
(Contract DE-FG05-92ER-54149)
(DE92-040510; DOE/ER-54149/1) Avail: CASI HC A02/MF A01

A study to investigate impurity production and transport in the divertor and edge regions of the Alcator C-Mod tokamak through spectroscopic techniques is described. A 0.75 m Czerny-Turner spectrometer with a 1200 g/mm grating and a 35 m quartz optic bundle transmission line were tested. A high resolution 2 m spectrometer will be ordered. Data acquisition considerations are being addressed. DOE

N93-16029# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.
DIAGNOSIS OF PLASMA STATES IN X RAY LASER EXPERIMENTS
Yang Shangjin, Cai Yuqin, and Chunyu Shutai 8 Oct. 1992 16 p Transl. into ENGLISH from unidentified Chinese language document p 73-78
(AD-A256909; FASTC-ID(RS)T-0619-92) Avail: CASI HC A03/MF A01

At an LF-12 laser installation, an Nd glass laser of approximately 1.5 ns pulse width with 500 to 600 J was focussed into a line 120 micrometers wide and 20 mm long and then onto a 1.5 mm thick germanium plane target. A plane crystal spectrograph (wavelength measurement range was between 0.6 and 0.9 nm) with a spatial resolving power was placed in the target chamber to diagnose the germanium plasma state. The corresponding intensity ratio between the quasi-Ne ion spectral lines with 2p-nd (n greater than or equal to 4) energy level transition was used to estimate the plasma electron temperature at 400 to 600 eV. In the laboratory, the measured line spectrum was mainly generated by quasi-Ne Ge XXIII ions; next were the spectral lines generated by quasi-F Ge XXIV ions; the spectral lines generated by quasi-Na Ge XXII ions were relatively weak. In addition, the axial-direction distribution uniformity of linear plasma, and the lateral-direction distribution characteristics of ions were provisionally observed. GRA

N93-16044# Oak Ridge National Lab., TN.
TRITIUM PELLET INJECTOR FOR THE TOKAMAK FUSION TEST REACTOR
M. J. Gouge, L. R. Baylor, S. K. Combs, P. W. Fisher, C. R. Foust, and S. L. Milora 1992 14 p Presented at the 43rd Aeroballistic Range Association Meeting, Columbus, OH, 28 Sep. - 2 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001205; CONF-9209211-1) Avail: CASI HC A03/MF A01

The tritium pellet injector (TPI) for the Tokamak Fusion Test Reactor (TFTR) will provide a tritium pellet fueling capability with pellet speeds in the 1- to 3-km/s range for the TFTR deuterium-tritium (D-T) plasma phase. An existing deuterium pellet injector (DPI) was modified at Oak Ridge National Laboratory (ORNL) to provide a four-shot, tritium-compatible, pipe-gun configuration with three upgraded single-stage pneumatic guns and a two-stage light gas gun driver. The TPI was designed for frozen pellets ranging in size from 3 to 4 mm in diameter in arbitrarily programmable firing sequences at tritium pellet speeds up to approximately 1.5 km/s for the three single-stage drivers and 2.5 to 3 km/s for the two-stage driver. Injector operation is controlled by a programmable logic controller (PLC). The new pipe-gun injector assembly was installed in the modified DPI guard vacuum box, and modifications were also made to the internals of the DPI vacuum injection line, including a new pellet diagnostics package. Assembly of these modified parts with existing DPI components was then completed and the TPI was tested at ORNL with deuterium pellets. Results of the testing program at ORNL are described. The TPI has been installed and operated on TFTR in support of the FY-92 deuterium plasma run period. In 1993, the tritium pellet injector will be retrofitted with a D-T fuel manifold and tritium gloveboxes and integrated into TFTR tritium processing systems to provide full tritium pellet capability. DOE

N93-16062# Department of the Navy, Washington, DC.
PLASMA REFLECTORS FOR ELECTRONIC BEAM STEERING IN RADAR SYSTEMS Patent Application
W. M. Manheimer, inventor (to Navy), A. E. Robson, inventor (to Navy), and R. A. Meger, inventor (to Navy) 7 Apr. 1992 29 p
(AD-D015399; US-Patent-Appl-SN-867862; Navy-Case-73830) Avail: CASI HC A03/MF A01

A method and apparatus for forming plasma sheets of preselected planar curvature, which can be used a mirrors for X-Band microwaves and above. A plasma is created using a shaped anode. Confining magnetic fields maintains the plasma in the shape of the cathode. Additional magnetic fields can provide additional curvature to the plasma sheet. Author (GRA)

N93-16091# Wisconsin Univ., Madison. Dept. of Physics.
THEORETICAL STUDIES OF TURBULENCE AND ANOMALOUS TRANSPORT IN TOROIDAL CONFINEMENT DEVICES
P. W. Terry 1992 8 p
(Contract DE-FG02-89ER-53291)
(DE93-000402; DOE/ER-53291/3) Avail: CASI HC A02/MF A01

The research performed under this grant has focused on key issues with respect to turbulence and transport in toroidal confinement devices. This work includes theoretical and computational studies of electron thermal confinement which have concentrated on the role of sheared poloidal flow in suppressing turbulence and transport, trapped ion convective cell turbulence and microtearing turbulence; analytical studies of anomalous particle transport and pinch mechanisms and comparison with experimental measurement; development of the theory of self-consistent radial transport of field-aligned momentum in the tokamak and RFP; and work on other topics (ion temperature gradient driven turbulence, RFP fluctuation theory, and coherent structures). Progress and publications in these areas are summarized. DOE

N93-16099# Los Alamos National Lab., NM.
SIMULATION OF A STRONGLY COUPLED PLASMA EXPERIMENT
W. R. Shanahan, J. F. Benage, Jr., and A. E. Greene 1992 4 p Presented at the International Conference on the Physics of Strongly Coupled Plasmas, Rochester, NY, 17-21 Aug. 1992
(Contract W-7405-eng-36)
(DE92-040351; LA-UR-92-2649; CONF-9208135-2) Avail: CASI HC A01/MF A01

An experiment designed to study the properties of moderately to strongly coupled plasmas, featuring the discharge of a capacitor bank through hollow and metal-filled capillaries encased in an insulating block, is simulated with a magnetohydrodynamic numerical code. Emphasis is placed on those features of the experiment which determine the maximum coupling achievable. For the hollow capillary, rapid heating of plasma blown off the sides of the capillary yields elevated temperatures that limit the ion-ion coupling to 0.5. Simulations employing an aluminum-fined capillary yield lower temperatures and persistent coupling parameters greater than 1. Comparisons with experimental data are presented. DOE

N93-16103# Oak Ridge National Lab., TN.
ADVANCED MATERIALS: THE KEY TO ATTRACTIVE MAGNETIC FUSION POWER REACTORS
E. E. Bloom 1992 10 p Presented at the 4th International Symposium on Advanced Nuclear Research, Mito City (Japan), 1-8 Feb. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040637; CONF-920264-2) Avail: CASI HC A02/MF A01

Fusion is one of the most attractive central station power sources from the viewpoint of potential safety and environmental impact characteristics. Studies also indicate that fusion can be economically competitive with other options such as fission reactors and fossil-fired power stations. However, to achieve this triad of characteristics we must develop advanced materials with properties tailored for performance in the various fusion reactor systems. This paper discusses the desired characteristics of materials and the status of materials technology in four critical areas: (1) structural material for the first wall and blanket (FWB); (2) plasma-facing materials; (3) materials for superconducting magnets; and (4) ceramics for electrical and structural applications. DOE

N93-16123# National Inst. for Fusion Science, Nagoya (Japan).
THE 3D MHD STUDY OF HELIAS AND HELIOTRON

T. Hayashi, T. Sato, W. Lotz, P. Merkel, J. Nuehrenberg, and U. Schwenn Sep. 1992 16 p
(AD-A257116; NIFS-168) Avail: CASI HC A03/MF A01

Properties of magnetic islands induced by the finite pressure effect are numerically analyzed for three-dimensional magnetohydrostatic equilibria of Helias and l = 2 heliotron/torsatron types. For Helias, it is found that an island chain is generated on the 5/6 rational surface, when such a surface appears in the plasma region of a finite-B equilibrium. The island chain, however, is not so dangerous as to destroy the plasma confinement even if it appears in a vanishingly small shear region. Moreover, it is definitely confirmed that the finite pressure effect sometimes exhibits a surprisingly good aspect, namely, that the vacuum islands are removed as B increases, which can be called 'self-healing' of islands. This property can be explained by the numerically discovered fact that the phases of islands induced by the finite pressure effect are always locked, i.e. do not change regardless of B. The way islands appear at finite-B for heliotron/torsatron is significantly different from that for Helias. However, we find the self-healing of islands can also occur for the heliotron configuration. This phenomenon can partly explain the reason why the fragility of surfaces decreases when they are shifted inward by control of the external vertical field Bv, though the configuration develops a magnetic hill. Furthermore, we analyze the diversion properties of the magnetic field outside the last closed magnetic surface for finite-B equilibria, and find that divertor concepts which have been developed from the diversion properties of the corresponding vacuum fields can be maintained for finite-B equilibria for both configurations. GRA

N93-16145# George Washington Univ., Washington, DC. Office of Sponsored Research.
NEW HIGH TEMPERATURE PLASMAS AND SAMPLE INTRODUCTION SYSTEMS FOR ANALYTICAL ATOMIC EMISSION AND MASS SPECTROMETRY
A. Montaser 1992 40 p
(Contract DE-FG05-87ER-13659)
(DE92-040602; DOE/ER-13659/6) Avail: CASI HC A03/MF A01

New high temperature plasmas and new sample introduction systems are explored for rapid elemental and isotopic analysis of gases, solutions, and solids using mass spectrometry and atomic emission spectrometry. Emphasis was placed on atmospheric pressure He inductively coupled plasmas (ICP) suitable for atomization, excitation, and ionization of elements; simulation and computer modeling of plasma sources with potential for use in spectrochemical analysis; spectroscopic imaging and diagnostic studies of high temperature plasmas, particularly He ICP discharges; and development of new, low-cost sample introduction systems, and examination of techniques for probing the aerosols over a wide range. DOE

N93-16152# Oak Ridge National Lab., TN.
FLUCTUATION STUDIES OF ECH PLASMAS IN THE ATF TORSATRON AND THE IMS STELLARATOR
J. H. Harris, J. B. Wilgen, M. Murakami, L. R. Baylor, T. S. Bigelow, R. J. Colchin, R. A. Dory, N. Dominguez, J. L. Dunlap, and G. R. Dyer et al 1992 11 p Presented at the 14th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Wuerzburg (Germany), 30 Sep. - 7 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001204; CONF-920913-4) Avail: CASI HC A03/MF A01

The results of experimental studies of fluctuations and transport in ECH plasmas in the ATF torsatron and the IMS stellarator are presented. In ATF, a variety of diagnostics have been used to measure turbulence amplitudes and spectral characteristics throughout the plasma. In the plasma core, density fluctuations with characteristics like those expected for drift waves (possibly connected with trapped electron effects) are seen. In the gradient region, the density fluctuation levels are consistent with those expected for resistive interchange turbulence. In the edge, fluctuations appear to be correlated with density gradients, and the fluctuation-induced particle flux and global particle confinement can be influenced by positive limiter biasing. In IMS, whose parameters model those in the edge of larger devices, two-dimensional (2-D) probe measurements show substantial poloidal variations in the fluctuation-induced particle flux that are most pronounced at the plasma edge; as in ATF, the particle flux can be reduced by positive limiter biasing. The 2-D probe measurements also show good agreement between the plasma poloidal flow velocities determined from the Reynolds stress and force balance. DOE

N93-16185# College of William and Mary, Williamsburg, VA.
THEORETICAL PLASMA PHYSICS
A. H. Boozer and G. M. Vahala May 1992 24 p
(Contract DE-FG05-84ER-53176)
(DE92-040854; DOE/ER-53176/8) Avail: CASI HC A03/MF A01

Work during the past year in the areas of classical and anomalous transport, three-dimensional equilibria, divertor physics, and diagnostic techniques using waves is reported. Although much work was done on classical transport, the validity of the guiding-center drift equations, which are the basis of much of the theory, has received little attention. The limitations of the drift approximation are being studied. Work on three-dimensional equilibria, which shows that quasi-helical symmetry is broken in third order in the inverse aspect ratio, on the modification of the current profile due to tearing modes was completed. This work is relevant to the maintenance of a steady-state tokamak by the bootstrap current. Divertor physics is a primary area that required development for ITER. One of the few methods by which the physics of the divertor can be modified or controlled is magnetic perturbations. The effect of magnetic perturbations on the divertor scrapeoff layer in collaboration with Hampton University is being studied. The evolution of magnetic field embedded in a moving plasma is a dynamics problem of potential importance. Renormalization techniques gave important insights first in the theory of phase transitions. The applications of these techniques has extended to many areas of physics, including turbulence in fluids and plasmas. Essentially no diagnostics for magnetic fluctuations inside a fusion-grade plasma exist. A collaborative program with Old Dominion University and the Princeton Plasma Physics Laboratory to develop such a diagnostic based on the conversion of electromagnetic waves from the ordinary to the extraordinary mode is underway. DOE

N93-16226# Los Alamos National Lab., NM.
MERCURY: A SECOND-GENERATION KrF LASER FOR INERTIAL FUSION RESEARCH
I. J. Bigio, G. York, J. McLeod, J. Czuchlewski, E. Rose, D. E. Hanson, N. A. Kurnit, and A. McCown 1992 6 p Presented at the 9th International Symposium on Gas Flow and Chemical Lasers, Heraklion, Greece, 21-25 Sep. 1992
(Contract W-7405-eng-36)
(DE93-000698; LA-UR-92-3164; CONF-920959-1) Avail: CASI HC A02/MF A01

The 'Mercury' KrF laser facility at Los Alamos is being built with the benefit of lessons learned from the Aurora KrF laser. An increased understanding of KrF laser engineering, and the designed implementation of system flexibility, will permit Mercury to serve as a testbed for a variety of advanced KrF technology concepts. DOE

N93-16229# Sandia National Labs., Albuquerque, NM.
DIAGNOSTIC BEHAVIOR OF THE WIRE ARC PLASMA SPRAY PROCESS
K. A. Kowalsky (Flame-Spray Industries, Inc., Port Washington, NY.), D. R. Marantz (Flame-Spray Industries, Inc., Port Washington, NY.), R. A. Neiser, and M. F. Smith 1992 7 p Presented at the 1992 International Thermal Spray Conference, Orlando, FL, 1-5 Jun. 1992
(Contract DE-AC04-76DP-00789)
(DE93-000717; SAND-92-1288C; CONF-9206135-7) Avail: CASI HC A02/MF A01

Laser two-focus (L2F) velocimetry has been used to measure particle velocities in the Wire Arc Plasma spray process. Particle velocities were measured for aluminum, stainless steel, and copper feedstock with wire diameters of 1.6 mm and 0.9 mm. The Wire Arc Plasma gun was operated in both a single-gas mode, using air, and in a two-gas mode, using a mixture of argon/35 percent hydrogen as the primary plasma gas with pure argon as the secondary gas. The results indicate that maximum particle velocities are as high as 180 m/s for aluminum sprayed using air and 130 m/s using the argon/hydrogen mixture. The results also show that arc current and wire feed rate have little effect on particle velocity; however, particle velocities increase significantly with decreasing wire diameter and with decreasing density of the feedstock material. DOE

N93-16237# Japan Atomic Energy Research Inst., Tokyo.
EXPERIMENTAL EVIDENCE OF OFF-DIAGONAL TRANSPORT TERM AND THE DISCREPANCY BETWEEN ENERGY/PARTICLE BALANCE AND PERTURBATION ANALYSES
Keisuke Nagashima (Japan Atomic Energy Research Inst., Naka.) and Takeshi Fukuda (Japan Atomic Energy Research Inst., Naka.) Dec. 1991 23 p
(DE92-556732; JAERI-M-91-208) Avail: CASI HC A03/MF A01

Evidence of temperature gradient driven particle flux was observed from the sawtooth induced density propagation phenomenon in JT-60. This off-diagonal particle flux was confirmed using the numerical calculation of measured chord integrated electron density. It was shown that the discrepancies between thermal and particle diffusivities estimated from the perturbation method and energy/particle balance analysis can be explained by considering the flux equations with off-diagonal transport terms. These flux equations were compared with the E x B convective fluxes in an electro-static drift wave instability and it was found that the E x B fluxes are consistent with several experimental observations. DOE

N93-16241# Wisconsin Univ., Madison.
PLASMA PHYSICS RESEARCH IN THE MST TOROIDAL CONFINEMENT DEVICE
1992 6 p
(Contract DE-FG02-85ER-53198)
(DE93-000491; DOE/ER-53198/199) Avail: CASI HC A02/MF A01

A list of projects is presented divided into three categories. The first list of 'completed physics projects' includes studies which have reached firm conclusions which have been or are being submitted for publication. The second list of 'ongoing projects' are mostly physics tasks which are underway. The third list of 'diagnostic development' tasks includes completed general-use machine diagnostics and special-purpose diagnostics under development. The division between the last two lists is somewhat arbitrary. The list of projects includes both major group efforts and low-level tasks. DOE

N93-16274# Oak Ridge National Lab., TN.
SMALL STEADY-STATE TOKAMAK (TST) FOR DIVERTOR TESTING
Y. M. Peng, R. J. Colchin, D. W. Swain, B. E. Nelson, J. F. Monday, J. Blevins (Canadian Fusion Fuels Technology Project, Mississauga, Ontario), M. Delisle (Canadian Fusion Fuels Technology Project, Mississauga, Ontario), J. Stringer (Canadian Fusion Fuels Technology Project, Mississauga, Ontario), P. Bonoli (Massachusetts Inst. of Tech., Cambridge.), and M. DeLisle (Canadian Fusion Fuels Technology Project, Mississauga, Ontario) et al 1992 22 p Presented at the 17th Symposium on Fusion Technology, Rome, Italy, 14-18 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001213; CONF-920930-2) Avail: CASI HC A03/MF A01

The TST is a small steady-state tokamak designed for testing diverters under conditions similar to those anticipated in future large tokamaks. An initial design has R sub 0/a = 2.5, R sub 0 = 0.75 m, a = 0.3 m, and Bt sub 0 = 2.2 T with full inductive capability. With heating and current drive power of 4.5 MW, the heat flux at the plasma edge Q(perpendicular) can be as high as 0.3 MW/sq m. Plasma currents I sub p above 500 kA can be maintained by 1 MW of lower hybrid power (2.45 GHz) for average densities n sub e up to 3 x 10(exp 19)/cu m. Additional power via ICRF (2 MW) and neutral beams (1.5 MW) maintain current for n sub e up to 5 x 10(exp 19)/cu m. Fully demountable, actively cooled, steady state toroidal field coils permit ample access for the auxiliary systems and diverter cassettes. The toroidal field magnets require a steady state supply of less than 40 MW. The size and cost of the TST can be reduced by eliminating the solenoid, reducing Bt sub 0 to 1.4 T, and lowering R sub 0/a to 1.7. This option permits low-R sub 0/a experimentation while maintaining the capability for testing divertors but requires successful noninductive current initiation and maintenance in the low-R sub 0/a regime. DOE

N93-16307# General Atomic Co., San Diego, CA.
ENHANCEMENT OF D3-D NEUTRAL BEAM SYSTEM FOR HIGHER PERFORMANCE
R. Hong, A. P. Colleraine, D. H. Kellman, J. Kim, J. L. Luxon, A. Nerem, J. Phillips, and J. Wight Sep. 1992 5 p Presented at the 17th Symposium on Fusion Technology, Rome, Italy, 14-18 Sep. 1992
(Contract DE-AC03-89ER-51114)
(DE93-000878; GA-A-21034; CONF-920930-6) Avail: CASI HC A01/MF A01

The D3-D tokamak employs eight neutral beam systems for plasma heating and current drive experiments. These positive ion source neutral beam systems have gone through several improvements in operational technique and in system hardware since the start of conditioning of the first long pulse ion source in December 1986. These improvements have led to the routine operation in deuterium at beam power levels of 20 MW. The improvements in operational technique include filament power supply operating mode, accelerator grid voltage holding capability, mid changes in grid potential gradients. The hardware improvements include installation of arc notching, arc discharge density regulation, and control of neutralizer gas puffing. Each of these improvements are discussed in this paper. Successful testing and operation of the ion source at 93 kV deuterium beam energy, well above the design value of 80 kV, also led to the possibility of enhancing system capability to 28 MW power level, nearly twice the original design value. Upgrading of the beam system to 60 second pulse duration at the currently achieved power level is under consideration. Studies have shown that this pulse length extension can be achieved with improvements in beamline heat handling components and auxiliary systems, especially the power supply system. The drift duct (the section between neutral beam beamline and tokamak) upgrade and protection for the long pulse duration present the greatest challenges, and are crucial to achieving long pulse beam injection into the tokamak plasma. DOE

N93-16308# Texas Univ., Austin. Inst. for Fusion Studies.
CORRELATION THEORY OF A TWO-DIMENSIONAL PLASMA TURBULENCE WITH SHEAR FLOW
Y. Z. Zhang and S. M. Mahajan Sep. 1992 63 p
(Contract DE-FG05-80ET-53088)
(DE93-000880; DOE/ET-53088/570; IFSR-570) Avail: CASI HC A04/MF A01

When the ion sound effect is neglected, a wide class of electrostatic plasma turbulence can be modelled by a two-dimensional equation for the generalized enstrophy (Psi), an inviscid constant of motion along the turbulent orbits. Under the assumption of a Gaussian stochastic electrostatic potential, an averaged Green's function method is used to rigorously derive equations for the N-particle correlation functions for a dissipative and sheared flow. This approach is equivalent to the cumulant expansion method used to study the Vlasov-Poisson system. For various cases of interest, appropriate equations are solved to obtain the absolute level as well as the detailed structure of the two-point correlation function C(r), and its Fourier transform, the enstrophy spectral function I(k). Uniformly valid analytical expressions are derived for the dissipative but shearless case resulting in a 'fluctuation-dissipation' theorem relating the total spectral intensity to classical viscosity. These self-consistent results show a strong logarithmic modification of the mixing length estimates for the turbulence levels. DOE

N93-16376# Texas Univ., Austin. Inst. for Fusion Studies.
ELECTRON-TEMPERATURE-GRADIENT-INDUCED INSTABILITY IN TOKAMAK SCRAPE-OFF LAYERS
H. L. Berk, R. H. Cohen (Lawrence Livermore National Lab., CA.), D. D. Ryutov (Academy of Sciences, USSR, Novosibirsk), and Y. A. Tsidulko (Academy of Sciences, USSR, Novosibirsk) Aug. 1992 42 p
(Contracts DE-FG05-80ET-53088; W-7405-eng-48; DE-FG03-90ER-54079)
(DE93-000623; DOE/ET-53088/568; IFSR-568) Avail: CASI HC A03/MF A01

An electron temperature instability driven by the Kunkel-Guillory sheath impedance, has been applied to the scrape-off layer of tokamaks. The formalism has been generalized to more fully account for parallel wavelength dynamics, to differentiate between electromagnetic and electrostatic perturbations and to account for particle recycling effects. It is conjectured that this conducting wall instability leads to edge fluctuations in tokamaks that produce scrape-off widths of many ion Larmor radii approx. greater than 10. The predicted instability characteristics correlate somewhat with DIII-D edge fluctuation data, and the scrape-off layer width in the DIII-D experiment agrees with theoretical estimates that can be derived from mixing length theory. DOE

N93-16400# Department of the Navy, Washington, DC.
PLASMA PHYSICS, AND TRANSPORTATION AND USE OF POSITIVELY CHARGED PARTICLE BEAMS Patent Application
Steven P. Slinker, inventor (to Navy), Richard F. Hubbard, inventor (to Navy), and Glenn Joyce, inventor (to Navy) 13 Dec. 1991 17 p
(AD-D015398; US-Patent-Appl-SN-801248) Avail: CASI HC A03/MF A01

The invention pertains to plasma physics, and in particular to and transportation and use of positively charged particle beams. Particle beams of positively charged atoms have potentially a number of useful applications, among which are thin film deposition, semiconductor doping, use as a general laboratory tool, a source of pulsed neutrons (i.e., by impacting a suitable target), shock hardening of materials, advanced military weaponry, and, most interestingly, as the trigger in a nuclear fusion reactor. Unfortunately, a number of these applications require that after the beams are created in particle accelerators, they must travel a considerable distance to their targets. GRA

N93-16451# Oak Ridge National Lab., TN.
TOKAMAK TURBULENCE IN SELF-REGULATED DIFFERENTIALLY ROTATING FLOW AND L-H TRANSITION DYNAMICS
P. W. Terry (Wisconsin Univ., Madison.), P. H. Diamond (California Univ., San Diego, La Jolla.), B. A. Carreras, and K. Sidikman 1992 34 p Presented at the International Topical Conference on New Ideas in Tokamak Confinement, La Jolla, CA, 27-29 Jan. 1992
(Contracts DE-AC05-84OR-21400; DE-FG02-89ER-53291)
(DE93-000443; CONF-920142-2) Avail: CASI HC A03/MF A01

An analytical study of turbulence in the presence of turbulently generated differentially rotating flow is presented as a paradigm for fluctuation dynamics in L- and H-mode plasmas. Using a drift wave model, the role of both flow shear and flow curvature (second radial derivative of the poloidal ExB flow) is detailed in linear and saturated turbulence phases. In the strong turbulence saturated state, finite amplitude induced modification of the fluctuation structure near low order rational surfaces strongly inhibits flow shear suppression. Suppression by curvature is not diminished, but it occurs through a frequency shift. A description of L-H mode transition dynamics based on the self-consistent linking of turbulence suppression by differentially rotating flow and generation of flow by turbulent momentum transport is presented. In this model, rising edge temperature triggers a transition characterized by spontaneous generation of differentially rotating flow and decreasing turbulence intensity. DOE

N93-16503# Pittsburgh Univ., PA. Surface Science Center.
ELECTRON ENERGY LOSS INVESTIGATION OF HOLE-PLASMON EXCITATION FOLLOWING THE IN SITU DOPING OF Si(111) BY BORON
P. J. Chen, J. E. Rowe, and J. T. Yates, Jr. 28 Sep. 1992 24 p
(Contract N00014-82-C-0280)
(AD-A256924; TR-53) Avail: CASI HC A03/MF A01

High resolution electron energy loss spectroscopy (HREELS) measurements have been performed on Si(111) surfaces heavily p-doped by the decomposition of adsorbed decaborane. After thermal decomposition of the decaborane to produce B atoms on the surface, the low energy electron diffraction pattern shows a (square root of 3 x square root of 3) R30 deg periodicity due to the presence of 1/3 monolayer of boron in the second complete layer. The HREELS data exhibit two strong features: (1) the B-Si dipole mode at 96 meV and (2) a broad surface plasmon mode is observed at approx. 100 meV loss energy due to the free carriers in the region below the B-reconstructed surface layer. The electron energy dependence was studied of the surface plasmon mode in order to determine the feasibility of using HREELS to determine the depth profile of the free carriers due to B diffusion into the region 100 to 1000 A below the surface. Unexpectedly, it was found that kinematic factors play an important role in the electron energy range used, 1.5 to 28 eV, and thus limit the degree of quantitative information that can be obtained about the carrier depth profile from HREELS data. GRA

N93-16534# Grumman Aerospace Corp., Princeton, NJ.
HIGH BETA AND SECOND STABILITY REGION TRANSPORT AND STABILITY ANALYSIS
M. H. Hughes, M. W. Phillps, A. M. M. Todd, J. Krishnaswami, and R. Hartley Sep. 1992 90 p
(Contract DE-FG02-89ER-51124)
(DE93-000886; DOE/ER-51124/7) Avail: CASI HC A05/MF A01

This report describes ideal and resistive studies of high-beta plasmas and of the second stability region. Emphasis is focused on 'supershot' plasmas in TFIR where MHD instabilities are frequently observed and which spoil their confinement properties. Substantial results are described from the analysis of these high beta poloidal plasmas. During these studies, initial pressure and safety factor profiles were obtained from the TRANSP code, which is used extensively to analyze experimental data. Resistive MBD stability studies of supershot equilibria show that finite pressure stabilization of tearing modes is very strong in these high beta(p) plasmas. This has prompted a detailed re-examination of linear tearing mode theory in which we participated in collaboration with Columbia University and General Atomics. This finite pressure effect is shown to be highly sensitive to small scale details of the pressure profile. Even when an ad hoc method of removing this stabilizing mechanism is implemented, however, it is shown that there is only superficial agreement between resistive MBD stability computation and the experimental data. While the mode structures observed experimentally can be found computationally, there is no convincing correlation with the experimental observations when the computed results are compared with a large set of supershot data. We also describe both the ideal and resistive stability properties of TFIR equilibria near the transition to the second region. It is shown that the highest beta plasmas, although stable to infinite-n ideal ballooning modes, can be unstable to the so called 'infernal' modes associated with small shear. The sensitivity of these results to the assumed pressure and current density profiles is discussed. Finally, we describe results from two collaborative studies with PPPL. The first involves exploratory studies of the role of the 1/1 mode in tokamaks and, secondly, a study of sawtooth stabilization using ICRF. DOE

N93-16602# Oak Ridge National Lab., TN.
HIGH-SPEED REPETITIVE PELLET INJECTOR PROTOTYPE FOR MAGNETIC CONFINEMENT FUSION DEVICES
A. Frattolillo (Associazione EURATOM-CNEN Sulla Fusione, Frascati, Italy), M. Gasparotto (Associazione EURATOM-CNEN Sulla Fusione, Frascati, Italy), S. Migliori (Associazione EURATOM-CNEN Sulla Fusione, Frascati, Italy), G. Angelone (Associazione EURATOM-CNEN Sulla Fusione, Frascati, Italy), M. Baldarelli (Associazione EURATOM-CNEN Sulla Fusione, Frascati, Italy), F. Scaramuzzi (European Nuclear Energy Agency, Frascati, Italy), G. Ronci (European Nuclear Energy Agency, Frascati, Italy), S. K. Combs, and S. L. Milora 1992 6 p Presented at the 17th Symposium on Fusion Technology, Rome, Italy, 14-18 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001361; CONF-920930-11) Avail: CASI HC A02/MF A01

The design of a test facility aimed at demonstrating the feasibility of high-speed repetitive acceleration of solid D2 pellets for fusion applications, developed in a collaboration between Oak Ridge National Laboratory and ENEA Frascati, is presented. The results of tests performed at the CNPM/CNR on the piston wear in a repetitively operating two-stage gun are also reported. DOE

N93-16650# Japan Atomic Energy Research Inst., Tokyo.
JT-60 CONFIGURATION PARAMETERS FOR FEEDBACK CONTROL DETERMINED BY REGRESSION ANALYSIS
Makoto Matsukawa, Nobuyuki Hosogane, and Hiromasa Ninomiya Dec. 1991 33 p
(DE92-556731; JAERI-M-91-206) Avail: CASI HC A03/MF A01

The stepwise regression procedure was applied to obtain measurement formulas for equilibrium parameters used in the feedback control of JT-60. This procedure automatically selects variables necessary for the measurements, and selects a set of variables which are not likely to be picked up by physical considerations. Regression equations with stable and small multicollinearity were obtained and it was experimentally confirmed that the measurement formulas obtained through this procedure were accurate enough to be applicable to the feedback control of plasma configurations in JT-60. DOE

N93-16921# Wisconsin Univ., Madison. Dept. of Physics.
B4C SOLID TARGET BORONIZATION OF THE MST REVERSED-FIELD PINCH
D. J. DenHartog, M. Cekic, G. Fiksel, S. A. Hokin, R. D. Kendrick, S. C.

Prager, and M. R. Stoneking Oct. 1992 25 p
(Contract DE-FG02-85ER-53198)
(DE93-002736; DOE/ER-53198/205) Avail: CASI HC A03/MF A01

A solid rod of hot-pressed boron carbide is being used as the source of boron during boronization of MST. The most striking result of this procedure is the reduction in oxygen contamination of the plasma (O 3 radiation, characteristic of oxygen at the edge, falls by about a factor of 3 after boronization.). The radiated power fraction drops to about half its initial value. Particle reflux from the wall is also lowered, making density control simpler. The rod (12.7 mm diameter) is inserted into the edge plasma of normal high-power RFP discharges. B4C is ablated from the surface of the rod and deposited in a thin film (a-B/C:H) on the walls and limiters. The energy flux carried by 'superthermal' (not 'runaway') electrons at the edge of MST appears to enhance the efficient, non-destructive ablation of the boron carbide rod. DOE

N93-16925# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
THERMAL PLASMA PROCESSING OF MATERIALS
E. Pfender and J. Heberlein Feb. 1992 33 p
(Contract DE-FG02-85ER-13433)
(DE93-003118; DOE/ER-13433/4) Avail: CASI HC A03/MF A01

Emphasis has been on plasma synthesis of fine powders, plasma chemical vapor deposition (CVD), related diagnostics, and modeling work. Since plasma synthesis as well as plasma CVD make frequent use of plasma jets, the beginning has been devoted to plasma jets and behavior of particulates injected into such plasma jets. Although most of the construction of the Triple-Torch Plasma Reactor (TTPR) has already been done, modifications have been made in particular modifications required for plasma CVD of diamond. A new reactor designed for Counter-Flow Liquid Injection Plasma Synthesis (CFLIPS) proved to be an excellent tool for synthesis of fine powders as well as for plasma CVD. An attempt was made to model flow and temperature fields in this reactor. Substantial efforts were made to single out those parameters which govern particle size, size distribution, and powder quality in our plasma synthesis experiments. This knowledge is crucial for controlling the process and for meaningful diagnostics and modeling work. Plasma CVD of diamond films using both reactors has been very successful and we have been approached by a number of companies interested in using this technology for coating of tools. DOE

N93-16973# Texas Univ., Austin. Inst. for Fusion Studies.
MAP MODEL FOR NONLINEAR ALPHA PARTICLE INTERACTION WITH TOROIDAL ALFVEN WAVES
H. L. Berk, B. N. Breizman, and H. Ye Sep. 1992 30 p
(Contract DE-FG05-80ET-53088)
(DE93-001851; DOE/ET-53088/566; IFSR-566) Avail: CASI HC A03/MF A01

A map model has been developed for studying the nonlinear interaction of alpha particles with the toroidal Alfven eigenmodes. The map is constructed by assuming a linear interaction during a single poloidal transit, which allows the study of the nonlinear interaction over many transits. By using this map, analytic expressions are obtained for the particle nonlinear bounce frequency, and the wave amplitude threshold for the onset of particle orbit stochasticity. The map model can also facilitate self-consistent simulations which incorporate the time variation of the waves. DOE

N93-16974# Texas Univ., Austin. Inst. for Fusion Studies.
MULTIPLE-GAP THEORY OF TOROIDAL ALFVEN WAVES WITH KINETIC EFFECTS
X. D. Zhang, Y. Z. Zhang, and S. M. Mahajan Sep. 1992 20 p
(Contract DE-FG05-80ET-53088)
(DE93-001852; DOE/ET-53088/573; IFSR-573) Avail: CASI HC A03/MF A01

The stability of kinetic toroidal Alfven waves with multi-gap coupling is analyzed by using the two-dimensional ballooning transform. An alternate convergence scheme, based on the smallness of the inverse aspect ratio, is devised. The resulting wave functions are oscillatory and do not balloon in contrast to the wave functions of conventional ballooning theory. It is shown that the single-gap theory is a special, weak shear (s yields 0) limit of the formalism. Analytical and numerical results for the two fundamental branches, the ideal toroidal Alfven eigenmode (TAE), and the kinetic toroidal Alfven eigenmode (KTAE) are presented and discussed. DOE

N93-16985# General Atomic Co., San Diego, CA.
CURRENT DRIVE WITH FAST WAVES, ELECTRON CYCLOTRON WAVES, AND NEUTRAL INJECTION IN THE D3-D TOKAMAK
R. Prater, C. C. Petty, R. I. Pinsker, S. C. Chiu, J. S. deGrassie, R. W. Harvey, H. Ikel, Y. R. Lin-Liu, T. C. Luce, and R. A. James Sep. 1992 18 p Presented at the Topical Conference Meeting on Radio Frequency Heating and Current Drive of Fusion Devices, Brussels (Belgium), 7-10 Jul. 1992
(Contracts DE-AC03-89ER-51114; DE-AC02-78ET-51013; DE-AC02-76CH-03073; DE-AC05-84OR-21400)
(DE93-001359; GA-A-21003; CONF-920717-5) Avail: CASI HC A03/MF A01

Current drive experiments have been performed on the D3-D tokamak using fast waves, electron cyclotron waves, and neutral injection. Fast wave experiments were performed using a 4-strap antenna with 1 MW of power at 60 MHz. These experiments showed effective heating of electrons, with a global heating efficiency equivalent to that of neutral injection even when the single pass damping was calculated to be as small as 5 percent. The damping was probably due to the effect of multiple passes of the wave through the plasma. Fast wave current drive experiments were performed with a toroidally directional phasing of the antenna straps. Currents driven by fast wave current drive (FWCD) in the direction of the main plasma current of up to 100 kA were found, not including a calculated 40 kA of bootstrap current. Experiments with FWCD in the counter current direction showed little current drive. In both cases, changes in the sawtooth behavior and the internal inductance qualitatively support the measurement of FWCD. Experiments on electron cyclotron current drive have shown that 100 kA of current can be driven by 1 MW of power at 60 GHz. Calculations with a Fokker-Planck code show that electron cyclotron current drive (ECCD) can be well predicted when the effects of electron trapping and of the residual electric field are included. Experiments on driving current with neutral injection showed that effective current drive could be obtained and discharges with full current drive were demonstrated. Interestingly, all of these methods of current drive had about the same efficiency, 0.015(10)(exp 20) MA/MW/sq m. DOE

N93-17003# California Univ., Los Angeles. School of Engineering and Applied Science.
MAGNETIC FUSION THEORY AND EXPERIMENTAL RESEARCH AND DEVELOPMENT
1992 35 p
(Contract DE-FG03-86ER-53225)
(DE93-002539; DOE/ER-53225/T7) Avail: CASI HC A03/MF A01

Radial currents have been used for generating plasma rotation. Particularly, oscillating torque experiments were performed. The resulting changes in the particle and heat transport were studied. Controlled variation in the poloidal asymmetry as well as in the plasma potential were induced by biasing. The particle confinement appears to be related to the sign of the radial electric potential. This is connected to the radial electric field and the direction of rotation. The electron diamagnetic drift direction is better. This corresponds to negative electric fields and potential. The poloidal asymmetry was studied in relation to heat confinement. DOE

N93-17035# MSE, Inc., Butte, MT.
MAGNETOHYDRODYNAMIC PROJECTS AT THE CDIF
1992 13 p
(Contract DE-AC22-88ID-12735)
(DE93-001854; DOE/ID-12735/T24) Avail: CASI HC A03/MF A01

This quarterly technical progress report presents the tasks accomplished at the Component Development and Integration Facility (CDIF) during the third quarter of FY92. Areas of technical progress this quarter included: Coal system development; seed system development; test train/A-Bay modifications; channel power dissipation and distribution system development; and integrated topping cycle current consolidators. DOE

N93-17037# California Univ., Los Angeles. Inst. of Plasma and Fusion Research.
THE ARIES-1 TOKAMAK REACTOR STUDY, VOLUME 2
1991 639 p

(Contracts DE-FG03-86ER-52126; W-31-109-eng-38; DE-AC03-89ER-52153; DE-AC07-76ID-01570; W-7405-eng-36)
(DE93-002185; UCLA-PPG-1323-Vol-2) Avail: CASI HC A99/MF A06

This report contains an overview of the Aries-I tokamak reactor study. The following topics are discussed on this tokamak: systems studies; equilibrium, stability, and transport; summary and conclusions; current drive; impurity control system; tritium systems; magnet engineering; fusion-power-core engineering; power conversion; Aries-I safety design and analysis; design layout and maintenance; and start-up and operations. DOE

N93-17085# Wisconsin Univ., Madison.
THEORETICAL REVERSED FIELD PINCH AND TOKAMAK STUDIES
1992 3 p
(Contract DE-FG02-85ER-53212)
(DE93-002775; DOE/ER-53212/198) Avail: CASI HC A01/MF A01

In previous work, electrostatic fluctuations that couple the free energy sources of resistive interchange turbulence (resistive g mode) and resistivity gradient driven turbulence (Rippling mode) were studied analytically and numerically. Evaluation of the predicted fluctuation levels using realistic MST parameters and the best estimates of equilibrium profiles yielded levels that appeared to be too small to agree with experiment. This work calls into question the standard scenario in which g modes (or rippling modes) are presumed to govern edge transport and account for the high frequency fluctuation activity in the RFP. DOE

N93-17199# Wisconsin Univ., Madison.
LONG WAVELENGTH MAGNETIC FLUCTUATIONS IN TOROIDAL PLASMAS
C. C. Hegna and J. D. Callen Oct. 1992 7 p Presented at the 1992 Cargese Magnetic Turbulence and Transport Workshop, Cargese, France, 6-12 Jul. 1992
(Contract DE-FG02-86ER-53218)
(DE93-002352; UW-CPTC-92-5; CONF-9207157-1) Avail: CASI HC A02/MF A01

Fluctuating bootstrap currents provide a mechanism for long wavelength electromagnetic fluctuations in tokamak plasmas. The existence of micro-magnetic islands may be responsible for the experimental observations of core density fluctuations. A fluctuation model is introduced for the tokamak that describes the magnetic topology as a time-varying mix of magnetic islands, stochastic zones, and 'good' magnetic surfaces. DOE

N93-17347# TRW Space Technology Labs., Redondo Beach, CA. Applied Technology Div.
MHD SEED RECOVERY/REGENERATION
1992 12 p
(Contract DE-AC22-87PC-79672)
(DE93-000904; DOE/PC-79672/T3) Avail: CASI HC A03/MF A01

Task 1 calls for the design, procurement, construction, and installation of the Seed Regeneration Proof-of-Concept Facility (SRPF) that will produce tonnage quantities of recyclable potassium formate seed at a design rate of 250 lb/hr for testing in the channel at the CDIF while collecting data that will be used to upgrade the design of a 300 MW(sub t) system. Approximately 12 tons of KCOOH (dry basis) as 70-75 wt percent solution were produced. The front end of the plant (potassium sulfate reaction and solids separation/washing units) was operated for five days in March. Most of the operations were conducted at a spent seed feed rate of 250 pounds/hour. A total of 8,500 gallons of dilute KCOOH solution was generated containing approximately 2.6 tons of potassium formate (dry basis). The average KCOOH content of this solution was 7 wt percent. The design KCOOH solution concentration for the front end of the plant is 8.5 wt percent. The evaporation unit was operated for a total of six days during March. Approximately 2.5 tons of potassium formate (dry basis) were processed through the evaporator and concentrated to greater then 7 wt percent. DOE

N93-17388# General Atomic Co., San Diego, CA.
NEW D3-D TOKAMAK PLASMA CONTROL SYSTEM
G. L. Campbell, J. R. Ferron, E. McKee, A. Nerem, T Smith, C. M. Greenfield, R. I. Pinsker, and E. A. Lazarus (Oak Ridge National Lab., TN.) Sep. 1992 5 p Presented at the 17th Symposium on Fusion Technology, Rome (Italy), 14-18 Sep. 1992
(Contract DE-AC03-89ER-51114)
(DE93-000877; GA-A-21036; CONF-920930-5) Avail: CASI HC A01/MF A01

A state-of-the-art plasma control system has been constructed for use on the DIII-D tokamak to provide high speed real time data acquisition and feedback control of DIII-D plasma parameters. This new system has increased the precision to which discharge shape and position parameters can be maintained and has provided the means to rapidly change from one plasma configuration to another. The capability to control the plasma total energy and the ICRF antenna loading resistance has been demonstrated. The speed and accuracy of this digital system will allow control of the current drive and heating systems in order to regulate the current and pressure profiles and divertor power deposition in the DIII-D machine. Use of this system will allow the machine and power supplies to be better protected from undesirable operating regimes. The advanced control system is also suitable for control algorithm development for future machines in these areas and others such as disruption avoidance. The DIII-D tokamak facility is operated for the U.S. Department of Energy by General Atomics Company (GA) in San Diego, California. The DIII-D experimental program will increase emphasis on rf heating and current drive in the near future and is installing a cryopumped divertor ring during the fall of 1992. To improve the flexibility of this machine for these experiments, the new shape control system was implemented. The new advanced plasma control system has enhanced the capabilities of the DIII-D machine and provides a data acquisition and control platform that promises to be useful far beyond its original charter. DOE

N93-17636# Royal Inst. of Tech., Stockholm (Sweden). Alfven Lab.
PRELIMINARY OBSERVATIONS OF ELECTROMAGNETIC RADIATION FROM PLASMA IN PRESENCE OF A DOUBLE LAYER
Lennart Lindberg Oct. 1991 21 p Sponsored by Swedish Natural Science Research Council
(TRITA-EPP-91-02; ETN-92-92623) Avail: CASI HC A03/MF A01

The electromagentic radiation in the near field region, outside the plasma, measured by means of small, electrostatically shielded loop probes is presented. In investigations of a double layer, a plasma region, with an intense, spontaneous HF generation was observed by means of internal HF probes. The region was located 50 to 200 Debyelengths from the double layer, on the high potential side. It was concluded that the HF field is generated by beam-plasma interaction, and can best be classified as electrostatic Langmuir waves. Such a wave field should in first approximation not radiate electromagnetic waves. The results of the analysis with the loop probes are presented. At the electron gyro frequency, a broad peak is seen in the spectrum, with spatial maximum outside the region in internal HF generation. Unexpectedly the azimuthal magnetic HF component is stronger than the axial component. At the plasma frequency a broad range of HF emission is seen, extending to the upper hybrid frequency. The spatial maximum is outside the region of intense interaction, and the axial component dominates, suggesting oscillations at the upper hybrid frequency. Groups of intensity peaks are also seen near the hybrid frequency. Probe design, shielding and calibration technique is described. ESA

N93-17637# Royal Inst. of Tech., Stockholm (Sweden). Alfven Lab.
EXPERIMENTAL OBSERVATIONS OF ANOMALOUS POTENTIAL DROPS OVER ION DENSITY CAVITIES
M. Bohm Aug. 1991 33 p
(TRITA-EPP-91-04; ETN-92-92625) Avail: CASI HC A03/MF A01

Experiments showing the plasma potential response when a step voltage is applied over the plasma column between the two plasma sources on a triple plasma machine are reported. The time resolution is sufficient to resolve potential variations caused by the electron motion, and two independent probe methods are used to obtain this time resolution. Two different responses were observed on the time scale of the electron motion. When the initial ion density varies along the plasma column and has a local minimum the applied potential drop becomes distributed over the cavity after a few electron transit times. Later the profile steepens to a double layer in the time scale of the ion motion. The width of the cavity is comparable to the length of the plasma column. When the initial density is axially uniform, most of the potential drop instead concentrates to a narrow region at the low potential end of the plasma column after a few electron transit times. On the time scale of the ion motion this potential drop begins to propagate into the plasma as a double layer. The results obtained

are consistent with those from numerical simulations with similar boundary conditions. Further experiments are necessary to get conclusive insight into the voltage supporting capability of an ion density cavity. ESA

N93-17649# Royal Inst. of Tech., Stockholm (Sweden). Alfven Lab.
STABILITY OF WEAK DOUBLE LAYERS
S. K. Turitsyn (Academy of Sciences, USSR, Novosibirsk), J. Juul Rasmussen (Risoe National Lab., Roskilde, Denmark), and Michael A. Raadu Apr. 1991 30 p
(TRITA-EPP-91-01; ETN-92-92622) Avail: CASI HC A03/MF A01

The transverse stability of weak double layers in plasmas with a two temperature electron component is investigated. The double layers appear as shocklike solutions of the modified Korteweg-de Vries equation with a negative coefficient of the cubic nonlinear term. The investigations are performed for an unmagnetized and a magnetized plasma. In the former case the two dimensional evolution of the double layer is governed by a modified Kadomstev-Petvishvili equation and the double layer is unstable. In a magnetized plasma the two dimensional evolution is governed by a modified Zakharov-Kuznetsov equation and the double layer is found to be stable. ESA

N93-17673# Dayton Univ., OH.
FORCE-FREE TIME-HARMONIC PLASMOIDS Interim Report, Nov. 1991 - Jul. 1992
Jack Nachamkin Oct. 1992 62 p
(Contract F04611-88-C-0020)
(AD-A257765; AD-E201274; PL-TR-92-3044) Avail: CASI HC A04/MF A01

An unexplored solution of Maxwell's equations is investigated for time-harmonic waves in a partially ionized gas. The analysis is focused on the spherically symmetric cases that behave like electromagnetic energy trapped in the form of a plasmoid. It will be shown that a critical frequency exists, below which the current cannot be carried by electrons and the plasmoid remains stable. Resonant sizes will be shown to exist such that plasmoids will not exchange energy with their external surroundings, and their boundary conditions can be met by vacuum solutions to Maxwell's equations. Virial analysis calculates free-change density and critical frequency to be consistent with Newtonian mechanics and classical electromagnetics. A stable vortical motion of the plasma will be shown to exactly cancel the dominant component of the electromechanical stresses, with the residual stresses being a strongly decreasing function of frequency. GRA

N93-17705# Tennessee Univ., Knoxville.
MICROWAVE INTERACTION WITH PLASMAS Final Report, 1 May 1989 - 30 Apr. 1992
Igor Alexeff 30 Apr. 1992 10 p
(Grant AF-AFOSR-0348-89)
(AD-A258044; AFOSR-92-0927TR) Avail: CASI HC A02/MF A01

During the past year, we have made progress on frequency shifting by means of plasmas. Theoretically we have demonstrated that a rising plasma density tends to slow down and trap microwaves passing through the plasma-filled region. This increases the interaction time, so that a very rapid rise in plasma density is not required to produce very high frequency shifts. A preliminary version has been submitted to the Transactions of Plasma Science, and a more updated version is in progress. An attempt to provide frequency upshifts by use of multiple transverse arcs was attempted without the use of equalizing resistors. The plasma discharge was observed, and the frequency upshift was seen, as was expected but it was not as extensive as in previous systems. A more balanced system is being developed. GRA

N93-17782# Montana State Univ., Bozeman. Dept. of Mechanical Engineering.
CORROSION AND ARC EROSION IN MHD CHANNELS
R. J. Rosa and R. J. Pollina Aug. 1992 61 p
(Contract DE-FG22-88PC-88928)
(DE93-001721; DOE/PC-88928/T17) Avail: CASI HC A04/MF A01

The problems connected with gas side corrosion for the design of the 1A4 (POC) channel hardware are explored and results of gas side wear rate tests in the Textron Mark VII facility are presented. It is shown that the proposed designs meet a 2000 hour lifetime criterion based upon these materials tests. Improvement in cathode lifetime is demonstrated with lower voltage intercathode gaps. The corrosion of these materials is discussed and it is shown how lifetimes are dependent upon gap voltage and average metal temperature. The importance of uniformity of slagging to the durability of the anode wall is demonstrated. The wear mechanism of the anodes in the MHD channel is analyzed. In addition to gas-side corrosion, the results of specific water corrosion tests of sidewall materials are discussed. All of the tests reported here were carried out to confirm the gas-side performance and the manufacturability of anode and sidewall designs and to address questions posed about the durability of tungsten-copper on the waterside. The results of water corrosion tests of the tungsten copper alloy sidewall material are presented to show that with proper control of waterside pH and, if necessary, dissolved oxygen, one can obtain reliable performance with no degradation of heat transfer with this material. The final choice of materials was determined primarily by the outcome of these tests and also by the question of the manufacturability of the prospective designs. DOE

N93-17801*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
STUDIES OF DYNAMIC PROCESSES RELATED TO ACTIVE EXPERIMENTS IN SPACE PLASMAS Final Report, 1 Aug. 1990 - 30 Sep. 1992
Peter M. Banks and Torsten Neubert 1992 74 p
(Grant NAGw-2055)
(NASA-CR-191771; NAS 1.26:191771) Avail: CASI HC A04/MF A01

This is the final report for grant NAGw-2055, 'Studies of Dynamic Processes Related to Active Experiments in Space Plasmas', covering research performed at the University of Michigan. The grant was awarded to study: (1) theoretical and data analysis of data from the CHARGE-2 rocket experiment (1keV; 1-46 mA electron beam ejections) and the Spacelab-2 shuttle experiment (1keV; 100 mA); (2) studies of the interaction of an electron beam, emitted from an ionospheric platform, with the ambient neutral atmosphere and plasma by means of a newly developed computer simulation model, relating model predictions with CHARGE-2 observations of return currents observed during electron beam emissions; and (3) development of a self-consistent model for the charge distribution on a moving conducting tether in a magnetized plasma and for the potential structure in the plasma surrounding the tether. Our main results include: (1) the computer code developed for the interaction of electrons beams with the neutral atmosphere and plasma is able to model observed return fluxes to the CHARGE-2 sounding rocket payload; and (2) a 3-D electromagnetic and relativistic particle simulation code was developed. Author

N93-16892*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PLASMA SEPARATION
Wolfgang Steurer *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 214-217 p 214-217 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

N93-17319*# Georgia Southwestern Coll., Americus. Dept. of Geology and Physics.
THE KAPPA DISTRIBUTION AS A VARIATIONAL SOLUTION FOR AN INFINITE PLASMA
Michael J. Pangia *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17320*# Florida Univ., Gainesville. Dept. of Physics.
STUDIES OF THE CHARGING OF A THIN DUST LAYER IN A PLASMA
Lennart R. Peterson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17324*# Marquette Univ., Milwaukee, WI. Dept. of Electrical and Computer Engineering.
ANALYSIS OF WAVES IN SPACE PLASMA (WISP) NEAR FIELD SIMULATION AND EXPERIMENT
James E. Richie *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty

Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

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Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N93-15714*# Cambridge Research and Instrumentation, Inc., MA.
WAVELENGTH TUNABLE LIQUID CRYSTAL IMAGING FILTERS FOR REMOTE SENSING FROM GEOSYNCHRONOUS PLATFORMS Final Report
Peter Foukal 22 Oct. 1992 16 p
(NASA Order H-11987-D)
(NASA-CR-184487; NAS 1.26:184487) Avail: CASI HC A03/MF A01

Recent advances in liquid crystal technology have enabled us to construct tunable birefringent filters with bandwidths between approximately 0.1 nm and 50 nm. The center wavelength of these filters can be selected electronically, in a few tens of milliseconds, with no moving parts. These liquid crystal tunable filters (LCTF's), together with existing CCD detectors, make possible a new generation of lightweight, rugged, high-resolution imaging spectrophotometers. Such instruments would be particularly interesting for remote sensing applications from geosynchronous platforms. Important advantages exist in the aperture, absence of image shift, power consumption, size, weight, and absence of high drive frequencies, compared to current instruments used or considered for multispectral scene analysis. In the present work, we have reviewed spectral requirements of planned NASA geosynchronous remote sensing missions and identified several applications of the liquid crystal tunable filter technology. We have modeled the LCTF performance in the visible and near-infrared, and carried out a literature study on space-hardening of the filter components, to evaluate the suitability of LCTF's for geosynchronous missions. We have also compared the power consumption, weight, size, reliability, and optical performance of an imaging spectrophotometer using a LCTF monochromator, to other instruments that have been put forward for remote sensing from geosynchronous platforms. We put forward some conceptual designs for LCTF's that seem to offer important reliability, over the mechanical filter wheels presently baselined for the HEPI and ALM experiments. The extremely wide acceptance angle achievable with LCTF's could also avoid the present need for large-aperture interference filters in the ALM (and LIS) experiments. Thermal vacuum testing and radiation damage analysis is required to investigate the space hardening of these new filters for geosynchronous flight. Author

N93-15816# Arizona State Univ., Tempe. Dept. of Electrical and Computer Engineering.
GROWTH STUDIES OF CVD-MBE BY IN-SITU DIAGNOSTICS Final Technical Report, 1 Jul. 1989 - 30 Jun. 1992
George N. Maracas and Timothy C. Steimle 29 Oct. 1992 39 p
(Contract N00014-89-J-3120)
(AD-A257216; DWA-1757) Avail: CASI HC A03/MF A01

This is the final technical report for the three year DARPA-URI program 'Growth Studies of CVD-MBE by in-situ Diagnostics'. The goals of the program were to develop non-invasive, real time epitaxial growth monitoring techniques and combine them to gain an understanding of processes that occur during MBE growth from gas sources. We have adapted these techniques to a commercially designed gas source MBE system (Vacuum Generators Inc.) to facilitate technology transfer out of the laboratory into industrial environments. The in-situ measurement techniques of spectroscopic ellipsometry (SE) and laser induced fluorescence (LIF) have been successfully implemented to monitor the optical and chemical properties of the growing epitaxial film and the gas phase reactants. The ellipsometer was jointly developed with the J. Woolam Co. and has become a commercial product. The temperature dependence of group 3 and 5 desorption from GaAs and InP has been measured as well as the incident effusion cell fluxes. The temporal evolution of the growth has also been measured both by SE and LIF to show the smoothing of heterojunction surfaces during growth interruption. Complicated microcavity optical device structures have been monitored by ellipsometry in real time to improve device quality. This data has been coupled with the structural information obtained from reflection high energy electron diffraction (RHEED) to understand the growth processes in binary and ternary bulk 3-5 semiconductors and heterojunctions. GRA

N93-15833# Argonne National Lab., IL.
THE EVOLUTION OF ELECTRONIC STRUCTURE IN Al(n)Co(m)
W. J. C. Menezes and M. B. Knickelbein 16 Sep. 1992 8 p Presented at the 6th International Symposium on Small Particles and Inorganic Clusters, Chicago, IL, 16-22 Sep. 1992
(Contract W-31-109-eng-38)
(DE92-040737; ANL/CP-76999; CONF-920921-2) Avail: CASI HC A02/MF A01

The ionization potentials of Al(n)Co(m) have been bracketed using laser photoionization mass spectrometry. We find that the electronic shell structure observed in the ionization potentials of Al(n) by Whetten and coworkers (Phys. Rev. Letters 64, 2539 (1990)) is largely preserved for Al(n)Co and Al(n)CO2, and is consistent with cobalt contributing one electron to the conduction band of the cluster. However, with increasing number of cobalt atoms, this simple model breaks down; all vestiges of aluminum cluster electronic shell structure are absent for m greater than 4. DOE

N93-15834# Argonne National Lab., IL.
ISOTOPE EFFECT IN (13)C-SUBSTITUTED (CENTRAL C=C) KAPPA-PHASE ORGANIC SUPERCONDUCTORS
U. Williams Geisere, K. D. Carlson, A. M. Kini, H. H. Wang, R. A. Klemm, J. R. Ferraro, S. K. Kumar, K. R. Lykke, P. Wurz, and S. Fleshler et al 1992 9 p Presented at the 1992 International Conference on Science and Technology of Synthetic Metals, Goeteborg (Sweden), Aug. 1992
(Contract W-31-109-eng-38)
(DE92-040748; ANL/CP-76908; CONF-9208132-2) Avail: CASI HC A02/MF A01

The organic electron-donor molecule ET (bis(ethylenedithio) tetrathiafulvalene) was synthesized twice by the identical route: (1) with natural C-12 carbon isotopic distribution; and (2) with 95 percent C-13, in the central C=C double bond position. The superconducting transition temperatures (in magnetic fields of 0.0-0.4 T) of single crystals prepared by both routes of ET synthesis were found, by the use of ac susceptibility measurements, to be identical within the precision of the measurements (approximately O.1 K or 1 percent) for the ambient-pressure superconductors kappa-(ET)2Cu(NCS)2 and kappa-(ET)2Cu(N(CN)2)Br. The absence of an effect of such isotopic replacement on Tc indicates that the central C=C stretching vibration (a high-energy optical mode at approximately 1500 cm(exp -1)) is not the dominant contributor to the superconducting pairing mechanism in these systems. DOE

N93-15836# Duke Univ., Durham, NC. Dept. of Mathematics.
DISPERSIVE REGULARIZATION OF SHOCKS Final Report, 1 Jun. 1991 - 31 May 1992
Stephanie Venakides 4 Sep. 1992 9 p
(Contract DAAL03-91-G-0178)
(AD-A257256; ARO-28969.2-MA) Avail: CASI HC A02/MF A01

In completed research we have (1) tested, with positive results, the Ansatz that is used in the higher order Lax-Levermore theory developed by us (with T. Zhang), and (2) shown the stability of solitary pulses through a semiconduction in the Gunn effect (with L.L. Bonilla). In on-going research we have (1) established strong results (analytically and numerically) in the semifinite Toda chain with time-dependent (periodic) forcing, (2) observed numerically that certain spectra in nonintegrable cases remain fixed in some averaged sense, and (3) made some progress in the longstanding problem of the initial-boundary value problem for the KdV equation. GRA

N93-15845# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PHOTOLUMINESCENCE STUDY OF Si(1-x)Ge(x)/Si AND Si/Ge STRAINED LAYER SUPER LATTICES Ph.D. Thesis
Todd D. Steiner 13 Jul. 1992 228 p
(AD-A256467; AFIT/DS/ENP/92-002) Avail: CASI HC A11/MF A03

In this dissertation, long-period Si(1-x)Ge(x)/Si superlattices grown by MBE at 500 C and annealed post-growth using rapid thermal annealing were investigated using photoluminescence (PL). The as-grown samples have broad PL bands from isoelectronic centers related to Ge complexes as well as sharp near-edge bound exciton lines. The broad PL band was

found to be 120 meV below the band gap, after accounting for the effects of confinement of holes. Annealing resulted in a reduction in the broad PL band activation energies and a shift of the broad band to higher energies. The reduction in the activation energies of the broad band were found to be due to the position of the emission centers within the Si(1-x)Ge(x) layers.The emission centers in the middle of the Si(1-x)Ge(x) were deactivated at higher temperatures than those at the edges, which caused the shift of the broad band to lower energies as the sample temperature increased. The shifts of the broad PL band as the annealing temperature increased were found to be due to a net shift of the emission centers towards the interfaces. GRA

N93-15862# Duke Univ., Durham, NC. Dept. of Chemistry.
X RAY CRYSTAL STRUCTURE OF AN ORGANOINDIUM ALKOXIDE DIMER, (Ph2InOSiMe3)2
Mark F. Self, Andrew T. McPhail, and Richard L. Wells 20 Oct. 1992 15 p
(Contract N00014-89-J-1545)
(AD-A257404; DU/DC/TR-31) Avail: CASI HC A03/MF A01

The solid-state structure of (Ph2InOSiMe3)2 1 has been established by single-crystal X ray analysis. Monoclinic crystals of 1 belong to space group P21/c, with a = 9.136(1), b = 15.503(2), c = 11.836(1) A, Beta = 102.46(1) degree, Z = 2. Refinement of atomic parameters converged at R = 0.050 (R, = 0.063) over 1718 observed reflections with I greater than 3.0o(I). The dimeric molecule lies on a crystallographic center of symmetry with In-O distance of 2.15(7) and 2.149(8) A, O-In-O = 78.9(3) degrees, and In = 101.1(3) degrees. Compound 1 is only the second example of a simple dimeric organoindium alkoxide to be structurally characterized in this manner. GRA

N93-15865# Emory Univ., Atlanta, GA. Dept. of Chemistry.
LASER-INDUCED DISSOCIATION OF HN3(DN3) ON GaAs(100) K
Y. Bu, L. Ma, and M. C. Lin 1992 20 p
(Contract N00014-89-J-1235)
(AD-A257426; TR-13) Avail: CASI HC A03/MF A01

HN3 (DN3) molecularly adsorbed on GaAs (100) at 100 K and formed dimers at higher dosages (greater than 20 L). Exposing the sample to 308 nm excimer laser radiation caused the dissociation of HN3 into HN and N2 species. The N2, residual HN3 and some HN species desorbed from the surface, as the irradiated sample was further annealed at 200 to 550 K. Both HREELS and XPS results indicated that NH species bonded to the As rather than the Ga atom on GaAs (100) under the present experimental conditions. GRA

N93-15875# Ballistic Research Labs., Aberdeen Proving Ground, MD.
CENTIMETER WAVE ABSORPTION IN MOLECULAR CRYSTALS Final Report, Jan. 1990 - Jun. 1991
Steve G. Cornelison, Arthur Gauss, Jr., Robert B. Bossoli, H. M. Lu, and J. R. Hardy Sep. 1992 29 p
(AD-A257453; BRL-MR-4002) Avail: CASI HC A03/MF A01

Molecular dynamics calculations performed at the University of Nebraska predict that temperature dependent microwave activity is present in some ionic molecular crystals. This activity is due to the excitation of 'hindered rotations' or thermally activated 'hopping' modes for the molecular ions. Microwave reflectometer measurements performed at the BRL show temperature dependent microwave losses occur in several ionic molecular crystals at or near the calculated order/disorder transition temperatures. These measurements, performed from 2 to 20 GHz from room temperature to about 300 C on the BRL 'arch,' were made on powder samples of the nitrates and nitrites of potassium, sodium, and other materials. Potassium nitrate displays an interesting temperature dependence with the absorption 'turning on' at about 1200 C, near the calculated order/disorder transition temperature. Measurements were also performed on selected ionic salts which uniformly show small microwave losses at any of the temperatures measured. GRA

N93-15905# Los Alamos National Lab., NM.
SUMMARY OF PHASE SEPARATION, STRUCTURE AND SUPERCONDUCTIVITY IN SUPER-OXYGENATED La2CuO(4+DELTA)
P. C. Hammel, E. T. Ahrens, A. P. Reyes, J. D. Thompson, Z. Fisk, P. C. Canfield, and J. E. Schirber 1992 18 p Presented at the Conference on Phase Separation in Cuprate Superconductors, Sicily (Italy), 6-12 May 1992
(Contract W-7405-eng-36)
(DE93-000855; LA-UR-92-3086; CONF-9205236-4) Avail: CASI HC A03/MF A01

We report the measurements of the excess content in oxygen-annealed La2CuO(4+delta). Below the phase separation temperature, T(PS), several features of the phase diagram for this material are unusual. The oxygen content changes discontinuously in both the oxygen-poor and oxygen-rich phases. Below this temperature, these change very little. We propose that the phase separation temperature is determined by the excess content of the oxygen-poor (antiferromagnetic) phase which in turn determines the Neel temperature. Phase separation occurs when the resulting sublattice magnetization is approximately 1/2 the zero temperature value. Bulk magnetization measurements show that the superconducting (Tc) is dependent on the cooling rate in a narrow temperature range well separated from T(PS). This and nuclear quadrupole resonance (NQR) provide evidence for the role of temperature dependent structural changes in this effect. The possible role of such changes in determining the normal state properties and the superconductivity is discussed. DOE

N93-15924# Argonne National Lab., IL.
PROGRESS TOWARD APPLICATION OF BULK HIGH-T(SUB c) SUPERCONDUCTORS
R. B. Poeppel, S. E. Dorris, J. Joo, D. Y. Kaufman, M. T. Lanagan, B. C. Prorok, J. P. Singh, C. T. Wu, and K. C. Goretta Aug. 1992 20 p Presented at the 3rd International Conference and Exhibition of the World Congress on Superconductivity, Munich (Germany), 14-19 Sep. 1992
(Contract W-31-109-eng-38)
(DE92-040735; ANL/CP-76328; CONF-920916-1) Avail: CASI HC A03/MF A01

Ag-clad wires have been fabricated from Bi2Sr2CaCu2O(x), Bi(1.8)Pb(0.4)Sr2Ca2Cu3O(x), and TlBa2Ca2Cu3O(x) superconductors by 'powder in tube' techniques. Critical current densities of 1 x 10(exp 5) A/sq cm at 4.2 K and 3 x 10(exp 4) A/sq cm at 77 K have been obtained. Additions of particulate Ag have been used to improve mechanical properties and promote partial melting during heat treatment. The processing sequences for the compounds had many common features, but also significant differences. The effects of processing on microstructure and properties are discussed. DOE

N93-15926# Argonne National Lab., IL.
PROCESSING HIGH-(Tc) SUPERCONDUCTORS WITH GeV HEAVY IONS
A. D. Marwick, L. Civale, L Krusin-Elbaum, T. K. Worthington, F. Holtzberg, R. Wheeler, and M. A. Kirk 1992 29 p Presented at the 8th International Conference on Ion Beam Modification of Materials, Heidelberg (Germany), 7-11 Sep. 1992
(Contract W-31-109-eng-38)
(DE92-040755; ANL/CP-77183; CONF-9209200-3) Avail: CASI HC A03/MF A01

Irradiation of high Tc superconducting crystals with low doses (10(exp 10) to 10(exp 11) ions/sq cm)) of GeV heavy ions (0.58 GeV Sn-116; 1.0 GeV Au-197) produces a unique microstructure consisting of discrete amorphous columns which are only a few nm in diameter but tens of microns long. It has been found recently that this columnar microstructure causes larger increases in magnetization and critical current at high temperature and high magnetic field than other types of defects in these materials. This can be understood as a consequence of the effective pinning of magnetic vortex lines provided by the columnar defects. Measurements confirm that the pinning is strongest when the magnetic field is aligned with the ion tracks. Differences in the pinning in different materials can be related to differences in their anisotropy, which affects the structure of the vortices and their pinning at columnar defects. DOE

N93-15928# Sandia National Labs., Albuquerque, NM.
EFFECT OF OXIDE THICKNESS ON INTERFACE-TRAP BUILDUP RATES
M. R. Shaneyfelt, J. R. Schwank, D. M. Fleetwood, and P. S. Winokur 1992 3 p Presented at the 1992 IEEE Semiconductor Interface Specialists Conference, San Diego, CA, 9-13 Dec. 1992
(Contract DE-AC04-76DP-00789)

(DE92-040981; SAND-92-1920C; CONF-921226-1) Avail: CASI HC A01/MF A01

The time dependence of radiation-induced interface-trap charge buildup for MOS transistors of varying gate-oxide thickness was investigated in order to clarify how the location of hydrogen in the SiO2 contributes to N(sub it) buildup. Radiation-induced interface-trap buildup in wet and dry gate oxides is compared for irradiations and anneals at constant positive bias and for negative-bias irradiations followed by positive-bias anneals. Implications of these results for different models of interface-trap buildup are discussed. DOE

N93-16014# Ames Lab., IA.
RADIO-FREQUENCY SURFACE IMPEDANCE OF TYPE-2 SUPERCONDUCTORS: DEPENDENCE UPON THE MAGNITUDE AND ANGLE OF AN APPLIED STATIC MAGNETIC FIELD
J. R. Clem and M. W. Coffey 1991 2 p Presented at the 3rd International Conference on Materials and Mechanisms of Superconductivity High Temperature Superconductors (M2S-HTSC-3): The Science of HTSC, Kanazawa, Japan, 22-26 Jul. 1991
(Contract W-7405-eng-82)
(DE92-040583; IS-M-719; CONF-910736-27) Avail: CASI HC A01/MF A01

The application of a static magnetic field introduces vortices into a type-2 superconductor. The dynamic response of these vortices strongly affects the surface impedance (surface resistance and surface reactance) of the superconductor. Using a self-consistent approach for including the influence of the vortices upon the complex-valued radio-frequency penetration depth, we calculate in this paper how the surface impedance depends upon the static magnetic field's magnitude and angle relative to the surface and to the RF magnetic field. The surface resistance is maximized when the induced RF currents are perpendicular to the static field. DOE

N93-16023# Illinois Univ., Urbana. Coordinated Science Lab.
ELECTRONIC TRANSPORT IN 3-5 SEMICONDUCTORS AND THEIR LATTICE MATCHED HETEROJUNCTIONS Final Report
K. Hess and G. E. Stillman 1992 7 p
(Contract N00014-86-K-0253)
(AD-A256904) Avail: CASI HC A02/MF A01

We have performed research on a broad range of phenomena related to nonlinear transport in semiconductor heterojunction layers. Results are briefly outlined and publications are listed. Author

N93-16043# Los Alamos National Lab., NM.
NQR STUDY OF LOCAL STRUCTURES AND COOLING RATE DEPENDENT SUPERCONDUCTIVITY IN La2CuO(4+DELTA)
A. P. Reyes, E. T. Ahrens, P. C. Hammel, R. H. Heffner, J. D. Thompson, P. C. Canfield, Z. Fisk, and J. E. Schirber 1992 12 p Presented at the 36th Conference on Magnetism and Magnetic Materials, Houston, TX, 1-4 Dec. 1992
(Contract W-7405-eng-36)
(DE93-000680; LA-UR-92-3022; CONF-921201-2) Avail: CASI HC A03/MF A01

Structural properties of oxygen-annealed polycrystals of La2CuO(4 + delta) (delta is approximately equal to 0.03) were studied using La-139 NQR spectroscopy. Superconducting critical temperatures were found to depend on the rate of cooling through a narrow temperature range at about 195 K. Preliminary analysis of the La-139 NQR spectra suggest that the oxygen-rich phase-separated region is composed of two structurally distinct phases, both of which are metallic and super-conducting. One phase has a structure closely related to the stoichiometric oxygen-poor compound. The second shows a considerable amount of apical oxygen disorder, a large shift in NQR frequency nu(sub Q), and a volume fraction which increases with cooling rate. The formation of the second phase below approximately 200 K is indicative of the freezing Of CuO6 octahedral tilting. Abrupt shifts in nu(sub Q) above T(sub c) were also observed for both phases, suggestive of a local structural anomaly or charge transfer to the Cu-O plane. DOE

N93-16050# Materials Research Society, Pittsburg, PA.
THE FOURTH INTERNATIONAL SYMPOSIUM ON Si-BASED MOLECULAR BEAM Final Report, 15 Apr. 1991 - 14 Apr. 1992
John Ballance 14 Apr. 1992 667 p Symposium held in Anaheim, CA, 29 Apr. - 3 May 1991
(Grant AF-AFOSR-0247-91)
(AD-A257241; AFOSR-92-0685TR) Avail: CASI HC A99/MF A06

The topics covered include the following: homoepitaxy and substrate preparation; doping; GeSi growth; GeSi optical properties; gesi electronic transport; device applications; epitaxial metals and insulators; novel materials and growth techniques; and light from porous silicon. GRA

N93-16071# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
TEMPERATURE DEPENDENCE OF SPECIES CONCENTRATIONS NEAR THE SUBSTRATE DURING CVD DIAMOND GROWTH
E. J. Corat and D. G. Goodwin 1 Oct. 1992 31 p
(Contract N00014-90-J-1386)
(AD-A256762; TR-4) Avail: CASI HC A03/MF A01

Measurements have been made of the temperature dependence of CH3, CH4, and C2H2 very near the substrate during filament-assisted diamond growth. CH3 was detected using (2+1) resonance-enhanced multiphoton ionization (REMPI), and CH4 and C2H2 concentrations were measured using sampling mass spectrometry. A strong dependence of the CH3 REMPI signal on substrate temperature was observed, which at low temperatures may be characterized as having an activation energy of approximately 4 +/- 1 kcal/mole. Methane and acetylene, on the other hand, are relatively independent of substrate temperature. These results are most likely due to recombination of methyl to methane in the cool gas layer near the substrate or on the surface at low substrate temperatures. GRA

N93-16081# Washington Univ., Bellingham. Dept. of Physics and Astronomy.
CHARACTERIZATION OF SEMI-INSULATING GALLIUM ARSENIDE Final Technical Report
John S. Blakemore 30 Sep. 1992 18 p
(Contract N00014-92-P-2000)
(AD-A257295) Avail: CASI HC A03/MF A01

This project's purpose was the electrical and optical characterization of samples from melt-grown crystals of gallium arsenide (GaAs). Almost all of the samples measured were undoped (nominally undoped), and almost all samples came from crystals grown at NRL by the vertical zone melt (VZM) method. A synopsis is provided of dc low-field electrical transport measurements in semi-insulating (SI) samples, as a function of temperature; observations of time dependent photoconductivity in SI GaAs; and two types of optical transmittance measurement - in the near infrared for observation of absorption by EL2 defects and in the mid infrared for observation of carbon local vibrational model absorption. Examples are provided. GRA

N93-16132# Sandia National Labs., Albuquerque, NM.
STRAINED QUANTUM WELL MODULATION-DOPED InGaSb/AlGaSb STRUCTURES GROWN BY MOLECULAR BEAM EPITAXY
J. F. Klem, J. A. Lott, J. E. Schirber, S. R. Kurtz, and S. Y. Lin (Princeton Univ., NJ.) 1992 14 p Presented at the Electronic Materials Conference, Cambridge, MA, 24-26 Jun. 1992
(Contract DE-AC04-76DP-00789)
(DE93-000755; SAND-92-0392C; CONF-920676-2) Avail: CASI HC A03/MF A01

Strained single quantum well InGaSb/AlGaSb structures for field-effect transistor applications have been grown by molecular beam epitaxy. Modulation-doped p-type structures have been characterized by a variety of techniques, including Hall effect, Shubnikov de Haas measurements, and cyclotron resonance. These structures exhibit improved hole transport in comparison to similar GaSb/AlGaSb structures as a result of strain-splitting of the valence band. P-channel field-effect transistors fabricated in this system exhibited a maximum transconductance of 51 and 161 ms/mm at 300 and 77K, respectively, for a 1.2 micron gate-length device. DOE

N93-16136# Texas Univ., Austin. Dept. of Electrical and Computer Engineering.
Si ATOMIC LAYER EPITAXY BASED ON Si2H6 AND REMOTE He PLASMA BOMBARDMENT
A. Mahajan, J. Irby, D. Kinosky, R. Qian, and S. Thomas 3 Jun. 1992

3 p
(AD-A255569; TR-1) Avail: CASI HC A01/MF A01

Atomic layer epitaxy (ALE) of silicon has been demonstrated by using remote helium plasma low energy bombardment to desorb H from a H-passivated Si(100) surface at low temperatures and subsequently chemisorbing disilane on the surface in a self limiting fashion in a Remote Plasma Chemical Vapor Deposition (RPCVD) System in which the substrate is downstream from an r-f noble gas (He or Ar) glow discharge in order to minimize plasma damage. It was found necessary to desorb the H from the Si surface to create adsorption sites for Si bearing species such as Si2H6. Optimal He bombardment parameters were to be 30 W at 100 mTorr He at 400 C for 1-3 min. Helium was found to be more effective than Ar bombardment because of the closer match of the He and H masses compared to that between Ar and H. Monte Carlo TRIM simulations of He and Ar bombardment of H-terminated Si surfaces were performed to validate this hypothesis and to predict that approximately 3 surface H atoms are displaced by the incident He atoms, with no Si atom displacement for the energies in the range of 15-60 eV. Alternate Si2H6 dosing and He low energy bombardment cycles (approximately 100-200) were performed to confirm ALE-mode of growth. It was found that the growth per cycle saturates with long Si2H6 dosing at a level which increases with He bombardment time. GRA

N93-16140# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.
A THEORETICAL SEARCH FOR SUPERVELOCITY SEMICONDUCTORS Annual Report
M. A. Littlejohn and K. W. Kim Oct. 1992 62 p
(Contract N00014-90-J-1553)
(AD-A256912) Avail: CASI HC A04/MF A01

The general goal of this research program has been and continues to be the investigation of high-speed carrier transport in 3-5 compound semiconductors, 3-5 alloy materials, other advanced electronic and optical materials, and novel device structures which utilize these materials. This research program has made significant contributions to the understanding and knowledge base of hot electron transport in materials and devices. It has provided scientific guidance to the U.S. Navy in the formulation of a part of its basic and applied research program. Our research results have helped stimulate commercial ventures, particularly in the development of GaInAsP-based materials and devices. GRA

N93-16164# Oak Ridge National Lab., TN.
CONDUCTION IN ION IMPLANTED SINGLE CRYSTAL DIAMOND
J. D. Hunn, N. R. Parikh, M. L. Swanson, and R. A. Zuhr 1992 18 p Presented at the 3rd International Conference on the New Diamond Science and Technology and Third European Conference on Diamond, Diamond-Like and Related Coatings, Heidelberg (Germany), 31 Aug. - 4 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040861; CONF-920854-1) Avail: CASI HC A03/MF A01

We have implanted sodium, phosphorus and arsenic into single crystal type IIa diamond as possible n-type dopants. Particular emphasis was applied to the implantation of sodium at different temperatures and doses; combined implantation energies of 55, 80 and 120 keV were used to provide a uniformly doped layer over approx. 100 nm depth. The implanted layers exhibited semiconducting behavior with a single exponential activation energy between 0.40 and 0.48 eV, as determined by temperature dependent resistance measurements. A sample implanted to a concentration of 5.10(exp 19) Na(+)/cu cm at 550 C exhibited a single activation energy of 0.415 eV over a temperature range from 25 to 500 C. Thermal annealing above 900 C was found to remove implantation damage as measured by optical absorption and RBS/channeling. However, concomitant increases in the resistance and the activation energy were observed. Implantation of Ne-22 was used to introduce a damage density equivalent to the Na-23 implant, while not introducing an electrically active species. The activation energy and electrical resistance were similar but higher than those produced by implantation with sodium. We conclude that the electrical properties of the Na-implanted samples were at least partly due to electrically active Na, but that residual implantation damage was still important. DOE

N93-16175# Research Triangle Inst., Research Triangle Park, NC.
HETEROEPITAXIAL DIAMOND GROWTH Quarterly Report No. 2, 1 Jul. - 30 Sep. 1992
R. J. Markunas, R. A. Rudder, R. E. Thomas, J. B. Posthill, and G. C. Hudson Nov. 1992 47 p
(Contract N00014-92-C-0081)
(AD-A257356; RTI/5294/92) Avail: CASI HC A03/MF A01

Work during this phase of the diamond program began to focus on issues which were limiting diamond technology: (1) The role of oxygen in diamond CVD; (2) Why the limited success of heteroepitaxy on Ni; (3) Tools for quantitative microstructural characterization; (4) Techniques for separation and lift-off of thin single crystal sheets of diamond; (5) Epitaxial consolidation of individual diamond crystals; and (6) High quality homoepitaxy. Highlights of this period include expounding the role of O in diamond CVD through surface chemistry, expounding the role of subsurface species to CH3 adsorption on Ni(111) surfaces, developing ion implantation annealing procedures for separation of diamond platelets, plan-view TEM characterization of type Ia and IIb diamonds, epitaxial consolidation of two adjacent diamonds, and critical evaluation of H2/CH4, H2/CH4/CO, H2/CO chemistries for homoepitaxial growth. GRA

N93-16179# Los Alamos National Lab., NM.
THE CRYSTAL STRUCTURES OF OXYGEN DEFICIENT RARE EARTH OXIDES
Jie Zhang, L. Eyring (Arizona State Univ., Tempe.), and R. VonDreele 1992 9 p Presented at the 15th Applied Crystallography Conference, Cieszyn (Poland), 10-12 Aug. 1992
(Contract W-7405-eng-36)
(DE92-040331; LA-UR-92-2601; CONF-9208134-1) Avail: CASI HC A02/MF A01

We have solved the structures of five members of the homologous series MnO(2n-2) for M = Pr and Tb from high resolution time-of-flight neutron powder diffraction data. All these structures are derived from the parent MO2 fluorite by creation of oxygen vacancies and subsequent lattice distortion. All have at least one common cell edge which is 1/2 of the zone axes (211) vector in fluorite. Apart from Tb7O12, these materials have remarkably low symmetry and very large unit cells; most are either monoclinic or triclinic. One of the largest of those solved is Pr10O18 whose monoclinic unit cell contains 112 atoms and is described by 84 atomic coordinates. The basic trend thus far observed in a comparison of these structures is that in the higher oxides where the mean lattice volume for each vacancy is ca. 200 cu A or larger, the vacancies are no longer paired on opposite sides of a metal atom as found in the rhombohedral M7O12 structure. This is consistent with the fact that the dominant bonding forces in rare-earth oxide systems is mainly ionic in nature. Thus, the formation of any intermediate phase in the homologous series is the result of minimizing the interactions between defect centers and does not involve any covalency effects which might preserve a large defect cluster in a dilute array of vacancies. DOE

N93-16194# Brookhaven National Lab., Upton, NY.
LOW-ENERGY PHYSICS OF HIGH-TEMPERATURE SUPERCONDUCTORS
V. J. Emery and S. A. Kivelson (California Univ., Los Angeles.) 1992 8 p Presented at the Conference on Fermiology of High Tc Superconductors, Argonne, IL, 25-27 Mar. 1991
(Contract DE-AC02-76CH-00016)
(DE92-040672; BNL-47823; CONF-9103112-8) Avail: CASI HC A02/MF A01

It is argued that the low-energy properties of high temperature superconductors are dominated by the interaction between the mobile holes and a particular class of collective modes, corresponding to local large-amplitude low-energy fluctuations in the hole density. The latter are a consequence of the competition between the effects of long-range Coulomb interactions and the tendency of a low concentration of holes in an antiferromagnet to phase separate. The low-energy behavior of the system is governed by the same fixed point as the two-channel Kondo problem, which accounts for the 'universality' of the properties of the cuprate superconductors. Predictions of the optical properties and the spin dynamics are compared with experiment. The pairing resonance of the two Kondo problem gives a mechanism of high temperature superconductivity with an unconventional symmetry of the order parameter. DOE

N93-16202# Argonne National Lab., IL.
FABRICATION AND PROPERTIES OF HIGH-T(SUB c) TAPES AND COILS MADE FROM SILVER-CLAD Bi-2223 SUPERCONDUCTORS
P. Haldar (Intermagnetics General Corp., Guilderland, NY.), J. G. Hoehn, Jr. (Intermagnetics General Corp., Guilderland, NY.), J. A. Rice (Intermagnetics General Corp., Guilderland, NY.), L. R. Motowidlo (IGC/Advanced Supercomputers, Inc., Waterbury, CT.), U. Balachandran, and C. A. Youngdahl Aug. 1992 9 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE92-040760; ANL/CP-77139; CONF-920802-13) Avail: CASI HC A02/MF A01

Long lengths of flexible silver-clad Bi-2223 high-(Tc) superconductors have been fabricated by the powder-in-tube technique. By improving process conditions, dc transport measurements at liquid helium (4.2 K) and hydrogen (20 K) temperatures yield J(sub c)'s greater than 10(exp 5) A/cm(exp 2) at zero field and exceed 3 x 10(exp 4) A/cm(exp 2) at liquid nitrogen (77K) temperature in short tape samples. Detailed microstructural analysis and J(sub c) measurements with applied fields up to 20 T are reported. Coils have been fabricated from 1 meter lengths of conductor with J(sub c)'s at 77 K approaching 10(exp 4) A/cm(exp 2). Measurements on small pancake coils made from 10 meter tapes are also reported. DOE

N93-16205# California Univ., Berkeley. Lawrence Berkeley Lab.
SIMULATION OF VORTEX-LINE PINNING BY DEFECTS IN THE Y-Ba-Cu-O SYSTEM
R. Jamison, C. P. Burmester, R. Gronsky, and L. T. Wille (Florida Atlantic Univ., Boca Raton.) Mar. 1992 6 p Presented at the Material Research Society Spring Meeting, San Francisco, CA, 27 Apr. - 2 May 1992
(Contract DE-AC03-76SF-00098)
(DE92-041185; LBL-32513; CONF-920402-59) Avail: CASI HC A02/MF A01

The temperature properties of a two-dimensional flux lattice are studied by Monte Carlo simulation, with particular attention to the effects of twin-boundaries. The parameters selected are appropriate for the YBa2Cu3O7 high-temperature superconducting system. The intrinsic properties of the vortex state are investigated by monitoring system evolution at fixed temperature and applied magnetic field. By varying the temperature, the loss of type-2 superconductivity via fluxoid lattice melting is also examined. The introduction of model defects induces the creation of metastable and glassy states which reduce overall hexane order but are found to enhance system resistance to flux-lattice melting. DOE

N93-16218# Oak Ridge National Lab., TN.
GROWTH AND PROPERTIES OF ULTRATHIN YBa2Cu3O7-DELTA LAYERS
D. P. Norton and D. H. Lowndes Sep. 1992 8 p Presented at the 6th Annual New York State Institute on Superconductivity Conference on Superconductivity and Applications, Buffalo, NY, 15-17 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001210; CONF-920944-1) Avail: CASI HC A02/MF A01

We report on the superconducting properties of ultrathin c-axis-oriented YBa2Cu3O(7-8) (YBCO) layers grown by pulsed-laser deposition. For single YBCO layers embedded in a PrBa2Cu3O(7-8) matrix, with a YBCO layer thickness as small as one unit cell, there is evidence of a superconducting transition. We also find that the superconducting properties of ultrathin YBCO layers can be significantly enhanced by use of more conductive buffer and cap layers. In particular, Pr(0.5)Ca(0.5)Ba2Cu3O(7-8) /YBCO/Pr(0.5)Ca(0.5)Ba2Cu3O(7-8) ultrathin structures have transport properties superior to PrBa2Cu3O(7-8) /YBCO/PrBa2Cu3O(7-8) including an increase in (Tc) and a narrower superconducting transition. DOE

N93-16243# Argonne National Lab., IL.
DIFFUSION-INDUCED GRAIN BOUNDARY MIGRATION DURING ION BEAM MIXING OF Au/Cu BILAYERS
D. E. Alexander, P. M. Baldo, and L. E. Rehn Sep. 1992 12 p Presented at the 8th International Conference on Ion Beam Modification of Materials, Heidelberg, Germany, 7-11 Sep. 1992
(Contract W-31-109-eng-38)
(DE93-000508; ANL/CP-76009; CONF-9209200-4) Avail: CASI HC A03/MF A01

Experiments were performed to evaluate the effect of 1.5 MeV Kr irradiation on diffusion-induced grain boundary migration (DIGM) in Au/Cu bilayers in the temperature range of 300 less than or = T less than or = 050 K. The experimental results were consistent with DIGM occurring in bilayers both during irradiation and during annealing treatments. Rutherford backscattering spectrometry showed a nearly uniform distribution of Cu present through the entire thickness of appropriately prepared polycrystalline Au films irradiated or annealed at temperatures greater than or = 400 K. No parallel effect was seen in similarly treated single-crystal films. In each polycrystalline sample studied, irradiation resulted in greater amounts of Cu present uniformly in the Au compared to annealing-only. The magnitudes of measured Cu compositions were substantially greater than that expected solely from grain boundary diffusion. A simple analysis of the process indicated that ion irradiation affects DIGM by increasing the composition of Cu present in alloyed zones and/or by increasing the grain boundary velocity in the Au. DOE

N93-16251# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
SOLID STATE RESEARCH Quarterly Technical Report, 1 Nov. 1991 - 31 Jan. 1992
Alan L. McWhorter 15 Feb. 1992 82 p
(Contract F19628-90-C-0002)
(AD-A256965; Rept-1992:1; ESC-TR-92-075) Avail: CASI HC A05/MF A01

The topics covered are Electrooptical Devices, Quantum Electronics, Materials Research, Submicrometer Technology, High Speed Electronics, Microelectronics, and Analog Device Technology. GRA

N93-16257# Massachusetts Inst. of Tech., Cambridge.
ICCG-10: THE 10TH INTERNATIONAL CONFERENCE ON CRYSTAL GROWTH Abstracts Only Final Report
August F. Witt Oct. 1992 313 p Conference held in San Diego, CA, 16-21 Aug. 1992
(Contract DAAL03-92-G-0042)
(AD-A256986; ARO-29062.1-MS-CF) Avail: CASI HC A14/MF A03

The conference was held as scheduled. Papers presented at the conference included those on fundamentals of nucleation and growth, crystal growth mechanisms, convection and segregation, morphological stability, dendrites and pattern formation, nonlinear optic crystals, oxide crystal growth, II-VI materials, laser materials, miscellaneous chaleogenides, silicon/germanium, wide bandgap materials, halides, superconductors, refractory compounds, biomaterials, and gel growth. GRA

N93-16267# Argonne National Lab., IL.
PHASE CHEMISTRY AND MICROSTRUCTURE EVOLUTION IN SILVER-CLAD (Bi(2-x)Pb(x)) Sr2Ca2Cu3O(y) FILAMENTS
J. S. Luo, N. Merchant, V. A. Maroni, E. Escorcia-Aparicio, D. M. Gruen, B. S. Tani, G. N. Riley, Jr. (American Superconductor Corp., Watertown, MA.), and W. L. Carter (American Superconductor Corp., Watertown, MA.) Aug. 1992 5 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE92-040716; ANL/CP-75798; CONF-920802-3) Avail: CASI HC A01/MF A01

The reaction kinetics and mechanism that control the conversion of (Bi,Pb)2Sr2CaCu2O(z) (Bi-2212) + alkaline earth cuporates to (Bi,Pb)2Sr2Ca2Cu3O(y) (Bi-2223) in silver-clad wires were investigated as a function of equilibration temperature and time at a fixed oxygen partial pressure (7.5 pct. O2). Measured values for the fractional conversion of Bi-2223 versus time have been evaluated based on the Avrami equation. SEM and TEM studies of partially and fully converted wires have revealed that (1) the growth of Bi-2223 is two-dimensional and controlled by a diffusion process, (2) liquid phases are present during part of the Bi-2212 yields Bi-2212 conversion, and (3) segregation of the second phases occurs in early time domains of the reaction. DOE

N93-16277# Argonne National Lab., IL.
SCALING LAWS FOR THE CRITICAL CURRENT DENSITY OF NbN FILMS IN HIGH MAGNETIC FIELDS
D. P. Hampshire (Durham Univ., England), K. E. Gray, and R. T. Kampwirth Aug. 1992 8 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992

(Contract W-31-109-eng-38)
(DE93-000604; ANL/CP-77433; CONF-920802-20) Avail: CASI HC A02/MF A01

The critical current density (Jc) was measured of two NbN films (500 and 1550 A thick) as a function of temperature in magnetic fields up to 25 Tesla using transport measurements. In both films, the functional form of the volume pinning force, F sub p, obeys the Fietz-Webb scaling law throughout the entire magnetic field and temperature range such that: F sub p = J sub c x B = alpha(B)sub c2 sup m(T)b sup 1/2 (1-b) sup 2 = (alpha)*(1-T/T sub c) sup m(b)sup 1/2 (1-b) sup 2 where alpha and (alpha)* are constants dependent on the film, B sub c2(T) is the upper critical field, b = B/B sub c2(T) is the reduced magnetic field, (Tc) is the critical temperature and we find m = 2.7 (+ or -) 0.1. Over a limited range of magnetic fields close to B sub c2(T), we can approximate this functional form by: F sub p = Beta(B)sub c2 sup M (T)b(1-b) sup 2 = (Beta)*(1-T/Tc) sup M(b)1-b sup 2 where (Beta) and (Beta)* are constants and we find M = 2.6(+ or -)0.2. Values of J sub c derived from D.C. magnetization data obtained using Bean's model show qualitative agreement with the transport measurements throughout the superconducting phase. Despite the marked granularity in the microstructure of these films, we interpret our results as evidence that a flux pinning mechanism determines the transport current density in NbN films in high magnetic fields. DOE

N93-16278# Argonne National Lab., IL.
MAGNETO-OPTIC CHARACTERIZATIONS OF SUPERLATTICES AND WEDGED SANDWICHES WITH OSCILLATORY INTERLAYER MAGNETIC COUPLING
S. D. Bader Jul. 1992 6 p Presented at the International Conference on the Physics of Transition Metals, Darmstadt, Germany, 20-24 Jul. 1992
(Contract W-31-109-eng-38)
(DE93-000607; ANL/CP-76266; CONF-920762-6) Avail: CASI HC A02/MF A01

Three examples of magnetic coupling across metallic spacer layers are considered. Fe/Nb sputtered superlattices are observed to have as many as five antiferromagnetic oscillations, but a weak magnetoresistive anomaly. Epitaxial trilayers of Fe/Mo/Fe grown on Mo(100) and Co/Cu/Co grown on Cu(100) are observed to have short and long period oscillations, respectively. The trilayers are grown with wedged spacer layers and characterized in-situ by means of the magneto-optic Kerr effect. DOE

N93-16296# Oak Ridge National Lab., TN.
GROWTH OF EPITAXIAL THIN FILMS BY PULSED LASER ABLATION
D. H. Lowndes 1992 90 p Presented at the International Conference on Crystal Growth, San Diego, CA, Aug. 1992
(Contract DE-AC05-84OR-21400)
(DE92-040515; CONF-920878-2) Avail: CASI HC A05/MF A01

High quality, high temperature superconductor (HTSc) films can be grown by the pulsed laser ablation (PLA) process. A detailed introduction is provided to the advantages and current limitations of PLA for epitaxial film growth. Emphasis is placed on experimental methods and on exploitation of PLA to control epitaxial growth at either the unit cell or the atomic-layer level. Examples are taken from recent HTSc film growth. DOE

N93-16301# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
GROWTH ON THE RECONSTRUCTED DIAMOND (100) SURFACE
S. J. Harris and D. G. Goodwin 1 Oct. 1992 39 p
(Contract N00014-90-J-1386)
(AD-A256954; TR-5) Avail: CASI HC A03/MF A01

A thermochemical kinetics analysis has been carried out for growth on the (100)-(2x1):H diamond surface using a pair of previously proposed mechanisms which operate sequentially. Half of the growth on such a surface is accounted for by insertion into dimer bonds, while the other half is accounted for by addition across troughs between dimer bonds. The latter mechanism is slower and therefore controls the over-all growth rate on this surface. This result can explain the success that the latter mechanism has had in predicting growth rates in a variety of systems. We suggest that growth at step sites is favored on steric and thermochemical grounds and can account for atomically smooth surfaces on diamond. GRA

N93-16358# Los Alamos National Lab., NM.
THREE-TERMINAL DEVICES OF HIGH-T(SUB c) SUPERCONDUCTORS: A STATUS REPORT AND FUTURE CHALLENGES
Pang-Jen Kung 1992 5 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-7405-eng-36)
(DE93-000654; LA-UR-92-3055; CONF-920802-15) Avail: CASI HC A01/MF A01

A study has been conducted on the recent progress of the three-terminal devices with transistor-like characteristics fabricated from the high-T(sub c) superconducting materials. This study explored the operating principles and characteristics of these devices in relation to the relevant materials and techniques. A comparison of a variety of techniques for superconducting thin film deposition will be given. This study indicates that the feasibility of fabricating hybrid devices composed of semiconductors and superconductors appear to be the key issue to push forward the applications of high-T(sub c) superconductors in microelectronics. The junction field-effect transistors with a semiconductor base controlled by the proximity effect are likely to be more manufacturable. The factors that influence the operating reliability of devices and the problems arising from integrating and packaging the devices will also be discussed. DOE

N93-16360# Ames Lab., IA.
RAPID TEXTURING OF HIGH TEMPERATURE SUPERCONDUCTORS FROM AMORPHOUS PRECURSORS Ph.D. Thesis
S. Arrasmith Sep. 1992 82 p
(Contract W-7405-eng-82)
(DE93-001217; IS-T-1571) Avail: CASI HC A05/MF A01

This study demonstrated that glass-ceramic processing (crystallization, sintering under uniaxial stress) in a uniaxial strain field can rapidly produce well-textured Bi-2212 (Bi2Sr2CaCu2O8). This process is sensitive to oxygen partial pressure and oxygen content. The material textured by this process remains weak linked even at low temperature and low applied magnetic fields. Parameters that need to be optimized include composition, oxygen content, and processing. DOE

N93-16390# Argonne National Lab., IL.
THE TETRAGONAL-MONOCLINIC TRANSFORMATIONS OF ZIRCONIA STUDIED BY SMALL ANGLE NEUTRON SCATTERING AND DIFFERENTIAL THERMAL ANALYSIS
Z. Li, J. E. Epperson, Y. Fang, and S. K. Chan Aug. 1992 15 p Presented at the 5th International Conference on the Science and Technology of Zirconia, Melbourne (Australia), 16-21 Aug. 1992
(Contract W-31-109-eng-38)
(DE92-040718; ANL/CP-75748; CONF-9208144-1) Avail: CASI HC A03/MF A01

The tetragonal-monoclinic transformations of zirconia have been studied on pristine single crystals and on their cycled crystallites. Two complementary techniques have been used. Small angle neutron scattering experiments were carried out to monitor the degree of completion of a transformation under equilibrium conditions for collections of 20-30 large crystals using the total internal and external surface area as an indicator. Differential thermal analysis experiments were carried out on smaller single-domain crystals of different sizes individually during heating and cooling to measure the rates of latent heat absorption and emission. The investigation establishes the upper limit of stability of the monoclinic phase, the lower limit of stability of the tetragonal phase, and the coexistence temperature between the two phases. The characteristics of the transformations are also inferred from these experiments. DOE

N93-16391# Argonne National Lab., IL.
NUCLEATION IN STRESS-INDUCED TETRAGONAL-MONOCLINIC TRANSFORMATION OF CONSTRAINED ZIRCONIA
S. K. Chan Aug. 1992 22 p Presented at the 5th International Conference on the Science and Technology of Zirconia, Melbourne (Australia), 16-21 Aug. 1992
(Contract W-31-109-eng-38)
(DE92-040720; ANL/CP-75749; CONF-9208144-2) Avail: CASI HC A03/MF A01

A theory for stress-induced tetragonal to monoclinic transformation of constrained zirconia is presented based on the assumption that when forcibly strained to a regime of absolute instability where the free energy

density of the tetragonal phase has a negative curvature, the constrained tetragonal zirconia becomes unstable with respect to the development of a modulated strain pattern that will evolve into a band of twin monoclinic domains. The temperature range for such an instability, the critical size of the inclusion, the corresponding critical strain, and the periodicity of the modulation are derived in terms of parameters that can be related to the elastic stiffness coefficients of various orders of the inclusion and the shear modulus of the host matrix. An entirely different mechanism is suggested for the reverse monoclinic to tetragonal transformation because the monoclinic phase is metastable when the extrinsic stress is removed. Estimates for the parameters are inferred from a variety of experimental data for pure zirconia and the numerical values for the predicted physical quantities are obtained. DOE

N93-16393# Argonne National Lab., IL.
CURRENT TRANSPORT ACROSS GRAIN BOUNDARIES IN TlBa2Ca2Cu3O(x) THICK POLYCRYSTALLINE FILMS AND YBa2Cu3O7 STEP EDGES

J. D. Hettinger, D. H. Kim, D. J. Miller, J. G. Hu, K. E. Gray, J. E. Sharping, K. Daly (TRW Space Technology Labs., Redondo Beach, CA.), C. Pettiett-Hall (TRW Space Technology Labs., Redondo Beach, CA.), and J. E. Tkaczyk (General Electric Co., Schenectady, NY.) Aug. 1992 5 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992

(Contract W-31-109-eng-38)

(DE93-000610; ANL/CP-77430; CONF-920802-21) Avail: CASI HC A01/MF A01

We have performed transport measurements in magnetic fields (H//c) up to 10T on a series of YBa2Cu3O7 grain boundaries induced by epitaxial growth on a substrate containing a series of step edges. For this material we find an activation energy which goes as U(T) approximately (1-t). Electric field versus current density curves taken at a constant temperature while varying the magnetic field allows a determination of the magnetic field dependence of the activation energy using the Ambagaokar-Halperin Model. These values agree with results extracted from the resistive transitions. Similar characterizations of a sample of TlBa2Ca2Cu3O(x) are also presented. The temperature dependence of the activation energy for this system may be summarized as U(T) approximately (1-t)(sup 2), suggesting that the grain boundaries behave as SNS juctions. DOE

N93-16445# Oak Ridge National Lab., TN.
MEASUREMENT OF FRACTURE TOUGHNESS IN THIN FILMS AND SMALL VOLUMES USING NANOINDENTATION METHODS

G. M. Pharr (Rice Univ., Houston, TX.), D. S. Harding (Rice Univ., Houston, TX.), and W. C. Oliver 1992 13 p Presented at the NATO Advanced Study Institute on Mechanical Properties of Materials Having Ultra-Fine Microstructure, Porto Novo, Portugal, 17 Jun. - 1 Jul. 1992

(Contract DE-AC05-84OR-21400)

(DE92-040711; CONF-9206271-2) Avail: CASI HC A03/MF A01

Nanoindentation methods are now used routinely in the characterization of the elastic modulus and hardness of thin films and small volumes of material. Herein, preliminary results are reported of a study aimed at developing a technique by which the toughness of a thin film or small volume can be determined. The method is based on the radial cracking which occurs when brittle materials are indented by a sharp indenter such as a Vickers diamond. In microindentation experiments, the lengths of radial cracks have been found to correlate reasonably well with fracture toughness, and a simple, semi-empirical method has been developed to compute toughness from measured crack lengths. However, a problem is encountered in extending the method into the nanoindentation regime in that there are well defined loads, called cracking thresholds, below which indentation cracking does not occur in most brittle materials. For a Vickers indenter, cracking thresholds in most ceramics are about 25 grams or more, i.e., loads well above those which would normally be used in nanoindentation. It was recently found, however, that the problems imposed by the cracking threshold can largely be overcome by changing the indenter geometry. Preliminary studies using a three-sided indenter with the geometry of a corner of a cube have revealed that cracking thresholds can be reduced to loads as small as 0.5 grams, for which indentations and crack lengths in most materials are sub-micron in dimension. The studies also indicate that the simple relationships between toughness and crack length used for Vickers indenters still applies provided a different empirical constant is used. Results of these studies are presented along with a brief review of the theory on which the method is based. DOE

N93-16449# California Univ., Berkeley. Lawrence Berkeley Lab.
CRYSTALLOGRAPHY OF Co/Pt MULTILAYERS AND NANOSTRUCTURES

Bing Zhang, K. M. Krishnan, and R. F. C. Farrow (IBM Research Lab., San Jose, CA.) Apr. 1992 24 p Presented at the 4th Conference on Frontiers of Electron Microscopy in Materials Science, Oakland, CA, 21-24 Apr. 1992

(Contract DE-AC03-76SF-00098)

(DE92-041212; LBL-32290; CONF-920450-1) Avail: CASI HC A03/MF A01

Atomically engineered nanostructures and multilayers of Co/Pt exhibit strong perpendicular anisotropy. This unique property, that determines their potential as a magneto-optic recording media, is dependent on a variety of microstructural parameters that include the overall crystallography, thickness of the layers, orientation, defect formation, interface reactions etc. A series of Co/Pt multilayer samples with different thickness of the Co layer were studied by electron diffraction. It has been determined that the Co layers persists in the fcc structure up to a thickness of 50 A. As the thickness is varied from 3 to 50 A in the multilayers, the Co film gradually relaxed to its bulk lattice parameter. (111) twinning and lattice strain at the interfaces between Pt and Co layers are also observed. The symmetry forbidden reflections observed at 1/3 (224) positions in (111) zone diffraction patterns of the multilayer are due to (111) twinning and compositional modulations along the multilayer growth direction. DOE

N93-16454# Argonne National Lab., IL.
THE CENTRAL BOND C-13 DOUBLE BOND C-13 ISOTOPE EFFECT FOR SUPERCONDUCTIVITY IN THE HIGH-T(SUB c) BETA*-(ET)(SUB 2)I(SUB 3) PHASE AND ITS IMPLICATIONS REGARDING THE SUPERCONDUCTIVITY PAIRING MECHANISM IN TTF-BASED ORGANIC SUPERCONDUCTORS

K. D. Carlson, J. M. Williams, U. Geiser, A. M. Kini, H. H. Wang, R. A. Klemm, S. K. Kumar, J. A. Schlueter, J. R. Ferraro, and K. R. Lykke et al 1992 10 p Presented at the European Conference on Molecular Electronics, Padua (Italy), 24-28 Aug. 1992

(Contracts W-31-109-eng-38; DE-AC04-76DP-00789)

(DE92-040725; ANL/CP-75668; CONF-920850-1) Avail: CASI HC A02/MF A01

We report a new study, based on magnetization measurements, of the isotope effect for C-13 substitution in the electronically active central double-bonded carbon atoms of the TTF moiety of ET (bis(ethylenedithio)tetrathiafulvalene) in beta*-(ET)(sub 2)I(sub 3) which is the crystallographically ordered form of beta-(ET)(sub 2)I(sub 3) produced by application of pressure. A recent report by Merzhanov et al. (C. R. Acad. Sci., Paris, 314, 563 (1992)) has shown that this same C-13 substitution leads to a 'giant' isotope effect (Delta T(c) = -0.6 K) in resistive determinations of T(c) (approximately 8 K) for beta*-(ET)(sub 2)I(sub 3), which lends experimental support to a theory by Yamaji (Solid State Common., 61, 413 (1987)) for salts of TTF-analogue donor molecules that includes optical phonons of symmetric intramolecular vibrations as a source of mediation for superconducting pairing of charge-carriers. In contrast to this result, our study shows the absence of an isotope effect within a precision of plus/minus 0.1 K (approximately 1 percent), indicating that the central atom C=C stretching motion (approximately 1500 cm(sup -1)) of ET cannot be a dominant mechanism for phonon exchange. Our results are consistent with those of a very recent study of the same isotope effect for kappa-(ET)(sub 2)Cu(N(CN(sub 2))Br and kappa-(ET)(sub 2)Cu(NCS)(sub 2) (Inorg. Chem., 32, 3356 (1992)). DOE

N93-16485 Department of the Navy, Washington, DC.
PROCESS FOR SINGLE CRYSTAL GROWTH OF HIGH T(c) SUPERCONDUCTORS Patent

William L. Lechter, inventor (to Navy), Louis E. Toth, inventor (to Navy), Badri N. Das, inventor (to Navy), and Stuart A. Wolf, inventor (to Navy) 7 Jan. 1992 4 p Filed 25 May 1989

(AD-D015480; US-Patent-5,079,220; US-Patent-Appl-SN-356496; US-Patent-Class-505-1) Avail: US Patent and Trademark Office

Large oriented crystals greater than one millimeter in length of high

T(c) superconducting compounds are grown by mixing starting materials in the correct proportions to make the superconducting compound, forming a mixture. The CO2 is removed from the mixture and the ternary oxide of the compound is formed from the mixture. Next, the mixture is formed into a self-supporting green body and sintered at a sintering temperature at which the top of the self-supporting green body is molten and the bottom surface is solid. The self-supporting green body is held at the sintering temperature for a time, forming a sintered body. Next, the sintered body is cooled so that crystals form. After this step, the crystals can be further processed to increase their superconducting properties. Finally, the crystals are removed and processed for use. GRA

N93-16486# Technische Univ., Delft (Netherlands).
ASPECTS OF ELECTRON TRANSPORT IN SEMICONDUCTOR NANOSTRUCTURES Ph.D. Thesis
Frank Willem Jan Hekking 1992 101 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie and Shell International Research Maatschappij N. V.
(ETN-92-92787) Avail: CASI HC A06/MF A02

Transport properties of systems which are smaller than some characteristic coherence length are studied. Focus is on quantum transport in a two Dimensional Electron Gas (2DEG), present at the interface of a semiconductor heterostructure. Small conductors can be defined in the 2DEG, through which an electron propagates phase coherently. Some basic theoretical concepts of quantum transport in such systems are reviewed. Magneto-transport properties of an array of 15 coupled quantum dots are studied. Effect of transport and gate voltage fluctuations in conductance quantization was studied. A simple device based on quantum adiabatic transport, that can work as an electron pump, is proposed. The photovoltaic effect due to gate voltage modulation in an asymmetric construction was studied. Transport properties of a superconductor, which is smaller than the temperature dependent coherence length, are discussed. ESA

N93-16489 Department of the Navy, Washington, DC.
METHOD OF MAKING Tl-Sr-Ca-Cu-OXIDE SUPERCONDUCTORS COMPRISING HEATING AT ELEVATED PRESSURES IN SEALED CONTAINER Patent
William L. Lechter, inventor (to Navy), Michael S. Osofsky, inventor (to Navy), Earl S. Skelton, inventor (to Navy), and Louis E. Toth, inventor (to Navy) 9 Jun. 1992 4 p Filed 8 Nov. 1989
(AD-D015482; US-Patent-5,120,704; US-Patent-Appl-SN-433245) Avail: US Patent and Trademark Office

High T(c) superconducting compounds are made by forming a reaction mixture of the oxides of Sr, Cu, Ca and Tl, compressing these into a hardened body, and placing the hardened body into a container. The container is then evacuated and sealed. The hardened body is heated under pressure until the oxides of Sr, Ca, Cu, and Tl react to form a superconducting compound. GRA

N93-16505# Massachusetts Inst. of Tech., Cambridge.
THE 10TH INTERNATIONAL CONFERENCE ON CRYSTAL GROWTH (ICCG-10)
21 Aug. 1992 236 p Conference held in San Diego, CA, 16-21 Aug. 1992
(Contract DAAL03-92-G-0042)
(AD-A256938; ARO-29062.MS-CF) Avail: CASI HC A11/MF A03

Poster topics include: fundamentals of nucleation and growth; crystal growth mechanisms; convection and segregation; morphological stability; dendrites and pattern formation; non-linear optic crystals; oxide crystal growth; II-VI materials; laser materials (oxides and fluorides); miscellaneous chalcogenides, silicon/germanium; III-V bulk growth, wide bandgap materials (SIC, diamond, nitrides); special techniques; halides; superconductors; special topics; refractory compounds; aqueous solution growth; biomaterials, industrial crystallization; and gel growth. GRA

N93-16525# California Univ., Berkeley. Lawrence Berkeley Lab.
CRYSTALLINE GROWTH OF WURTZITE GaN ON (111) GaAs
J. Ross (California Univ., Berkeley.), T. K. Gustafson (California Univ., Berkeley.), and M. Rubin Dec. 1991 6 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC03-76SF-00098)
(DE92-041165; LBL-32258; CONF-911202-85) Avail: CASI HC A02/MF A01

Gallium nitride films were grown on (111) gallium arsenide substrates using reactive RF magnetron sputtering. Despite a 20 percent lattice mismatch and different crystal structure, wurtzite GaN films grew epitaxially in basal orientation on (111) GaAs substrates. Heteroepitaxy was observed for growth temperatures between 550-600 C. X-ray diffraction patterns revealed (0002) GaN peak with a full-width-half-maximum (FWHM) as narrow as 0.17 degrees. Possible surface reconstructions to explain the epitaxial growth are presented. DOE

N93-16533# Brookhaven National Lab., Upton, NY. Material Science Div.
LARGE MAGNETIC FIELD INDUCED FLUCTUATION EFFECT IN SUPERCONDUCTING Bi2Sr2Ca2Cu3O10 TAPE
Qiang Li, M. Suenaga, T. Hikata (Sumitomo Electric Industries Ltd., Osaka, Japan), and K. Sato (Sumitomo Electric Industries Ltd., Osaka, Japan) 1992 3 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract DE-AC02-76CH-00016)
(DE92-041314; BNL-47891; CONF-920802-12) Avail: CASI HC A01/MF A01

We present our study on the magnetic field induced fluctuation effect in a highly textured Bi2Sr2Ca2Cu3O10 tape, based on the magnetization measurement. Extremely large induced excess diamagnetism in high fields was observed at temperatures down to 75 K. In weak fields, fluctuation significantly reduces the diamagnetism of this system just below T(c). The role of this large extended fluctuation effect played in the application of Bi-based superconductor family is discussed. DOE

N93-16581# Technische Univ., Delft (Netherlands).
INVESTIGATION OF III-V SUPERLATTICES AND HETEROSTRUCTURES BY CONVERGENT-BEAM ELECTRON DIFFRACTION Ph.D. Thesis
Hao Gong 1992 160 p
(ETN-92-92784) Avail: CASI HC A08/MF A02

The Convergent Beam Electron Diffraction (CBED) technique is developed and used for the evaluation of III-V semiconductors (with emphasis on GaAs/AlAs superlattices and GaInAsP heterostructures). The theory of CBED computation is outlined. Particular attention is given to the investigation of GaAs/AlAs multilayers. The fine structure of the First Order Laue Zone (FOLZ) reflections in CBED patterns of GaInAsP heterostructures is investigated. By using many beam dynamical calculations, the features in FOLZ reflections are explained. The effect of various parameters on the fine features in FOLZ discs is discussed and values of some parameters are estimated from the CBED patterns. The effect of illumination coherence as a first step to future CBED work is considered. ESA

N93-16598# Oak Ridge National Lab., TN. Solid State Div.
Au(111) AND Pt(111) SURFACE PHASE BEHAVIOR
A. R. Sandy (Massachusetts Inst. of Tech., Cambridge.), S. G. J. Mochrie (Massachusetts Inst. of Tech., Cambridge.), D. M. Zehner, G. Gruebel (Brookhaven National Lab., Upton, NY.), K. G. Huang (Brookhaven National Lab., Upton, NY.), and Doon Gibbs (Brookhaven National Lab., Upton, NY.) 1992 12 p Presented at the 12th International Vacuum Congress. 8: International Conference on Solid Surfaces, Hague, Netherlands, 12-16 Oct. 1992
(Contracts DE-AC05-84OR-21400; DE-AC02-76CH-00016)
(DE92-040881; CONF-9210161-1; CONF-9210162-1) Avail: CASI HC A03/MF A01

Recent x ray scattering studies are described of the structure and phases of the clean Au(111) and Pt(111) surfaces. Below 0.65 of their respective bulk melting temperatures, the Au(111) surface has a well-ordered chevron reconstruction and the Pt(111) surface is unreconstructed. Above these temperatures, both surfaces reconstruct to form layers that are isotropically compressed and have only short-range order. Throughout their reconstructed phases, the densities of the Au and Pt (111) surfaces increase with increasing temperature. DOE

N93-16734 Tel-Aviv Univ. (Israel). School of Chemistry.
EFFECTS OF NON-CRYSTALLOGRAPHIC SYMMETRY ON STRUCTURE FACTOR STATISTICS M.S. Thesis

Romem Shach Oct. 1992 132 p In HEBREW
(ITN-93-85182) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

Investigations of the effects of the presence of noncrystallographic (NC) symmetry, i.e., local symmetry not shared by the space group, on the distribution of the magnitude of the normalized structure factor, the absolute value of E, are presented. Several such symmetry elements were investigated for a range of crystallographic space groups by constructing exact Fourier representations of the probability density function (PDF) of the absolute value of E, which allow for the atomic composition and overall (crystallographic or NC) symmetry of the models studied. The investigations consist of (1) derivation of the Fourier coefficients for each PDF of interest, (2) a careful simulation of the PDF, based on the relevant structure-factor expression; and (3) a comparison of the exact Fourier PDF with the simulated one, and with the corresponding ideal PDF's: those based entirely on the central limit theorem approximation. ISA

N93-16831*# Scientific Research Associates, Inc., Glastonbury, CT.
AUTONOMOUS MAGNETIC FLOAT ZONE MICROGRAVITY CRYSTAL GROWTH APPLICATION TO TiC AND GaAs Final Report
Tony Y.-T. Chan and Sang-Keun Choi Oct. 1992 94 p
(Contract NAS8-38487)
(NASA-CR-191002; NAS 1.26:191002; SRA-R92-900080-F) Avail: CASI HC A05/MF A01

The floating zone process is ideal for high temperature (greater than 3000 K) growth of titanium carbide because it is containerless. However, float zoning requires small melt volumes in order to maintain a stable melt configuration. The short melt columns make it difficult to achieve a controlled thermal profile, a necessity for producing crystals of high quality. Thus, an automated control strategy based upon continuous monitoring of the growth process with processing parameters adjusted to values based upon the physical transport processes of the growth process is very desirable for maintaining stability and reproducibility of the process. The present work developed a Float-zone Acquisition and Control Technology (FACT) system which uses relations derived by combining empirical relations with a knowledge data base deduced from detailed numerical analysis of fluid mechanics and thermal transport of the growth process. The FACT system was assembled, tested and employed to grow two TiC ingots. One of the ingots was characterized by x-ray diffraction at different axial locations. The x-ray rocking curves showed consistent characteristics of a manually grown ingot. It was also found that with the FACT system, the process conditions can be operated closer to the stability limits, due to fast response time and repetitive amounts of adjustment from the FACT system. The FACT system shows a major potential in growing quality TiC crystals in a cost-effective manner. Author

N93-16929# Sandia National Labs., Albuquerque, NM.
SPECTROSCOPIC AND MICROSTRUCTURAL CHARACTERIZATION OF SOLUTION CHEMISTRY EFFECTS IN PZT THIN FILM PROCESSING
R. W. Schwartz, R. A. Assink, and T. J. Headley 1992 11 p Presented at the Material Research Society Symposium, Boston, MA, 2-6 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE92-008675; SAND-92-0175C; CONF-921206-1) Avail: CASI HC A03/MF A01

Ferroelectric PZT 53:47 thin films were prepared by two different solution deposition methodologies. Both routes utilized carboxylate and alkoxide precursors and acetic acid, which served as both a solvent and a chemical modifier. We have studied the effects of solution preparation conditions on film microstructure and ferroelectric properties, and have used NMR spectroscopy to characterize chemical differences between the two precursor solutions. Films prepared by a sequential precursor addition (SPA) process were characterized by slightly lossy hysteresis loops, with a P(sub r) of 18.7 micro-C/cm(exp 2) and an E(sub c) of 55.2 kV/cm. Films prepared by an inverted mixing order (IMO) process were characterized by well saturated hysteresis loops, a P(sub r) of 26.2 micro-C/cm (exp 2) and an E(sub c) of 43.3 kV/cm. While NMR investigations indicated that the chemical environments of both the proton and carbon species were similar for the two processes, differences in the amounts of by-products (esters, and therefore, water) formed were noted. These differences apparently impacted ceramic microstructure. Although both films were characterized by a columnar growth morphology, the SPA derived film displayed a residual pyrochlore layer at the film surface, which did not transform into the stable perovskite phase. The presence of this layer resulted in poor dielectric properties and lossy ferroelectric behavior. DOE

N93-16930# Los Alamos National Lab., NM.
DEPENDENCE OF BURIED CoSi2 RESISTIVITY ON ION IMPLANTATION AND ANNEALING CONDITIONS
F. Namavar, N. M. Kalkhoran, J. M. Manke (Spire Corp., Bedford, MA.), L. Luo, and J. T. McGinn (David Sarnoff Research Center, Princeton, NJ.) 1992 9 p Presented at the Material Research Society Symposium, Boston, MA, 2-6 Dec. 1992
(Contract W-7405-eng-36)
(DE92-010080; LA-UR-92-684; CONF-921206-3) Avail: CASI HC A02/MF A01

We have investigated the dependence of electrical and material properties of buried CoSi2 layers on Co(+) implantation and annealing conditions. The results indicated that the electrical resistivity and crystalline quality of the implanted buried CoSi2 layers depend strongly on the implantation temperature. CoSi2 layers with the lowest resistivity and best crystalline quality (chi(sub min) as low as 3.6 percent) were obtained from samples implanted at 300-400 C. Implantation at higher temperatures (e.g., 580 C) produced cobalt disilicide layers with significantly higher electrical resistivity and a chi(sub min) of about 10.7 percent. DOE

N93-16975# Sandia National Labs., Albuquerque, NM.
DISCREPANCIES BETWEEN CHARGE-PUMPING, DUAL-TRANSISTOR, AND MIDGAP MEASUREMENTS OF D(SUB IT)
J. R. Schwank, D. M. Fleetwood, and M. R. Shaneyfelt 1992 3 p Presented at the 1992 IEEE Semiconductor Interfact Specialists Conference, San Diego, CA, 9-13 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE92-040977; SAND-92-1919C; CONF-921226-4) Avail: CASI HC A01/MF A01

Several different techniques are used to electrically characterize defects at or near the Si/SiO2 interface. Three common methods are the charge-pumping, midgap, and dual-transistor techniques. Each of these techniques offer advantages and disadvantages compared to the others. For instance, charge-pumping measurements are not significantly affected by charge lateral non-uniformities and can provide high-sensitivity measurements of the average density of interface traps. However, charge-pumping measurements cannot provide accurate measurements of the number of charged oxide traps. In contrast, both the dual-tranistor and midgap techniques can provide good estimates for threshold-voltage shifts due to oxide traps and interface traps, but these estimates can break down when significant charge lateral non-uniformities are present in the oxide. Considering the widespread use of these techniques, it is of practical and theoretical importance to quantitatively compare them. At the SISC, we will present a detailed comparison of the charge-pumping, midgap, and dual-transistor techniques. Values for the density of interface traps measured using the three techniques will be compared for n- and p-channel transistors fabricated using several different process technologies; under different process technologies; and under different irradiation and anneal conditions. Discrepancies between the different techniques are observed. Causes for the discrepancies will be explored at the SISC. DOE

N93-16993# Rome Univ. (Italy). Dipt. di Fisica.
SU(3) LATTICE GAUGE FIXING WITH OVERRELAXATION AND GRIBOV COPIES
Maria Luigia Paciello (Istituto Nazionale di Fisica Nucleare, Rome, Italy), Claudio Parrinello (New York Univ., New York.), Silvano Petrarca (European Organization for Nuclear Research, Geneva, Switzerland), Bruno Taglienti (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and Anastassios Vladikas (Tor Vergata Univ., Rome, Italy) 31 Oct. 1991 13 p
(Preprint-839; ETN-93-92941) Avail: CASI HC A03/MF A01

The phenomenology of SU(3) lattice Landau gauge fixing as obtained by using an overrelaxation algorithm is reported. A result obtained using this algorithm is that distinct Gribov copies are generated by simply modifying the value omega of the overrelaxation parameter for a fixed starting configuration. By generating random gauge equivalent configurations, the variation of the number of copies with the lattice volume and gauge coupling are studied. Different minimization algorithms for F may converge to different Gribov copies. A preliminary study of the occurrence of Gribov copies in

the SU(3) Landau gauge as a function of (beta, V) is presented. An analysis on larger lattices enables the possible relation between the (gauge invariant) deconfinement transition and the decreased density of Gribov copies in the Landau gauge to be investigated. ESA

N93-17006# California Univ., Berkeley. Lawrence Berkeley Lab.
TEM STRUCTURE INVESTIGATIONS OF LOW-TEMPERATURE MBE GROWN InAlAs LAYERS ON InP GROUP OF ZONE AXES (001) SUBSTRATE
P. Werner, Z. Liliental-Weber, K. M. Yu, E. R. Weber, Z. Rek, and R. Metzger Apr. 1992 6 p Presented at the 1992 Material Research Society Spring Meeting, San Francisco, CA, 27 Apr. - 2 May 1992
(Contract DE-AC03-76SF-00098)
(DE92-041199; LBL-32470; CONF-920402-58) Avail: CASI HC A02/MF A01

The real crystal structure of In(0.52)Al(0.48)As layers grown on InP group of zone axes (001) substrate as a function of the growth temperature (between 150 and 450 C) was investigated. The following structural/electrical analyses were applied to the samples: transmission electron microscopy (TEM), x-ray diffraction, and particle induced x-ray emission (PIXE). In the temperature range between 200 and 450 C good epitaxial growth of InAlAs layers can be achieved with a low density of dislocations and stacking faults. Ordering of group-3 elements on (111) planes was observed for these layers. Structure models of such ordered domains are discussed. At growth temperatures below 300 C additional As (approximately 2 percent) is incorporated in the lattice. Growth at temperatures below 200 C leads to the formation of pyramidal defects with As grains in their cores. As-grown as well as annealed InAlAs layers show a nearly constant, high electrical resistance (10(exp 6)-10(exp 7)(Omega)cm) in the whole temperature range. DOE

N93-17025# Rome Univ. (Italy). Dipt. di Fisica.
ELECTRONIC STRUCTURE AND PHASE SEPARATION IN SUPERCONDUCTING CUPRATES
C. DiCastro and M. Grilli 27 May 1992 31 p
(Preprint-889; ETN-93-92989) Avail: CASI HC A03/MF A01

The implications of possible pairing mechanisms of the electronic structure and its correlation with the maximum critical temperature attained in the different cuprate families are reviewed. The three band Hubbard model and the technical tools used are presented. A magnetic Heisenberg coupling between the copper spin is added to the three band Hubbard model. The resulting extended tJ model is described. The model introducing the Kondo-like magnetic coupling is described. The related physics is discussed and phase separation and superconducting instabilities are analyzed. The extended Hubbard model is generalized by introducing the d(sub Z) orbital of the copper and the p(sub z) orbital of the out of plane oxygen ions. In this context the semiphenomenological correlation between the maximum critcal temperature in the various classes of materials and the symmetry of the hole states is presented. ESA

N93-17043*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
METHOD AND APPARATUS FOR CONTROLLING PROTEIN CRYSTALLIZATION Patent Application
David A. Noever, inventor (to NASA) 28 Aug. 1992 10 p
(NASA-Case-MFS-28688-1; NAS 1.71:MFS-28688-1;
US-Patent-Appl-SN-936376) Avail: CASI HC A02/MF A01

A method and apparatus for controlling the crystallization of protein by solvent evaporation including placing a drop of protein solution between and in contact with a pair of parallel plates and driving one of the plates toward and away from the other plate in a controlled manner to adjust the spacing between the plates is presented. The drop of solution forms a liquid cylinder having a height dependent upon the plate spacing thereby effecting the surface area available for solvent evaporation. When the spacing is close, evaporation is slow. Evaporation is increased by increasing the spacing between the plates until the breaking point of the liquid cylinder. One plate is mounted upon a fixed post while the other plate is carried by a receptacle movable relative to the post and driven by a belt driven screw drive. The temperature and humidity of the drop of protein solution are controlled by sealing the drop within the receptacle and mounting a heater and dessicant within the receptacle. NASA

N93-17055# Sandia National Labs., Albuquerque, NM.
PRESSURE AS A PROBE OF DEEP LEVELS AND DEFECTS IN SEMICONDUCTORS: GaAs, GaP AND THEIR ALLOYS
G. A. Samara 1992 6 p Presented at the 5th International Converence on High Pressure in Semiconductor Physics, Kyoto (Japan), 18-21 Aug. 1992
(Contract DE-AC04-76DP-00789)
(DE93-000714; SAND-92-2006C; CONF-9208165-1) Avail: CASI HC A02/MF A01

Measurements of the effects of pressure on the thermal electron emission rate and capture cross section for a variety of deep electronic levels in GaAs, GaP and their alloys have yielded the pressure dependences of the energies of these levels in the bandgaps, allowed evaluation of the breathing mode lattice relaxations accompanying carrier emission or capture by these levels and revealed trends which lead to new insights into the nature of the responsible defects. Emphasis is on deep levels believed to be associated with simple defects. Specifically, results will be summarized for the donor levels of the dominant native defect known as EL2 in CAM, which is believed to be associated with the arsenic antisite, and on the radiation-induced El and E2 levels in GaAs, GaP and their alloys, which are believed to be due to arsenic (or phosphorous) vacancies. The results are discussed in terms of models for the defects responsible for these deep levels. DOE

N93-17068# Rome Univ. (Italy). Dipt. di Fisica.
CP-VIOLATION IN K(SUP +/-) TO 3 PI DECAYS AND LATTICE QCD B-FACTORS
Gino Isidori (Istituto Nazionale di Fisica Nucleare, Rome, Italy), Luciano Maiani (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and Alessandra Pugliese (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 12 Dec. 1991 26 p
(Preprint-848; ETN-93-92950) Avail: CASI HC A03/MF A01

The Charge Conjugation and Space Inversion (CP) violating asymmetries in K(sup +/-) decays to 3 pi are evaluated in the framework of chiral perturbation theory. Lattice Quantum Chromodynamics (QCD) B factors are used to determine the matrix elements of the chiral operators. The effect of electroweak penguin operators are included. The resulting asymmetries are very small, of the order of few units in 10(exp 6) for the slope, and in 10(exp 8) for decay rates. The structure of the four quark effective hamiltonian and the numerical values of the quantities used in the analysis are given. The Lagrangian description of the amplitudes of the k decays to 2 pi and 3 pi is discussed. Formulae and results concerning the integrals that appear in the phase space and rescattering calculations are presented. ESA

N93-17075# Oak Ridge National Lab., TN. Solid State Div.
MAGNETIC STUDIES OF CURRENT CONDUCTION AND FLUX PINNING IN HIGH-T(SUB c) CUPRATES: VIRGIN, IRRADIATED, AND OXYGEN DEFICIENT MATERIALS
J. R. Thompson, Yang Ren Sun (Tennessee Univ., Knoxville.), J. G. Ossandon (Tennessee Univ., Knoxville.), D. K. Christen, H. R. Kerchner, B. C. Sles, B. C. Chakoumakos, L. Civale (IBM Watson Research Center, Yorktown Heights, NY.), A. D. Marwick (IBM Watson Research Center, Yorktown Heights, NY.), and F. Holtzberg (IBM Watson Research Center, Yorktown Heights, NY.) Sep. 1992 11 p Presented at the 6th Annual New York State Institute on Superconductivity Conference on Superconductivity and Applications, Buffalo, NY, 15-17 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001716; CONF-920944-4) Avail: CASI HC A03/MF A01

To increase the current density and pinning of magnetic flux in high temperature superconductors, defects with point-like and line-like geometries were created in controlled numbers using ion irradiation methods. Single crystals of Y1Ba2Cu3O7 and Bi2Sr2Ca1Cu2O8 superconductors were studied using dc magnetic methods. These studies showed greatly increased irreversibility in the vortex state magnetization and enhanced intragrain current density J(sub c) following irradiation. Linear defects, created by irradiation with energetic heavy ions, are particularly effective in pinning vortices at higher temperatures and magnetic fields. Further investigations of 'flux creep' (the time dependence of magnetization) are well described by recent vortex glass and collective pinning theories. Complementary investigations have delineated the role of oxygen deficiency (delta) on pinning in aligned Y1Ba2Cu3O(7-delta) materials. DOE

N93-17079# Connecticut Univ., Storrs.
ENERGY TRANSFER AND NON-LINEAR OPTICAL PROPERTIES AT NEAR ULTRAVIOLET WAVELENGTHS: RARE EARTH 4f YIELDS 5d TRANSITIONS IN CRYSTALS AND GLASSES
D. S. Hamilton Aug. 1992 59 p
(Contract DE-FG02-84ER-45056)
(DE93-002133; DOE/ER-45056/10) Avail: CASI HC A04/MF A01

The following topics were studied: two-photon transitions from 4f ground state to 5d excited states in Ce(3+):CaF2; optical absorption and photoionization measurements from excited state of Ce(3+):Y3Al5O12; excited state photoionization of Ce(3+) ions in Ce(3+):CaF2; optical gain and loss studies in Ce(3+):LiYF4; Gd yields Cr energy transfer in Cr(3+):GSGG, Cr(3+):GSAG, and Cr(3+):GGG crystals; nonradiative relaxation in Ce(3+) doped crystals and glasses; and grating formation in impurity doped crystals. DOE

N93-17081# Rochester Univ., NY. Dept. of Physics and Astronomy.
FLUX FLOW, PINNING, AND RESISTIVE BEHAVIOR IN SUPERCONDUCTING NETWORKS
S. Teitel Oct. 1992 10 p
(Contract DE-FG02-89ER-14017)
(DE93-002707; DOE/ER-14017/4) Avail: CASI HC A02/MF A01

We have studied the behavior of fluctuation effects in superconducting systems using numerical simulations of XY and Coulomb gas models. The fluctuation of vortex lines in high temperature superconductors, in the presence of an external magnetic field, has been studied using a three dimensional XY model. We have carried out new simulations on a more dilute vortex line model than we considered previously, and find surprising evidence that the process of vortex line lattice melting occurs as two distinct phase transitions. As the vortex line lattice is heated, it melts first into a vortex line liquid of straight unentangled lines, having superconducting properties in the direction along the lines (parallel to the external field), but not in directions transverse to the lines. At a higher temperature, the thermal excitation of closed vortex line loops links all the lines together, leading to a tangled vortex line liquid, with completely normal metal properties in all directions. We have also continued simulations of the two dimensional Coulomb gas, as a model for vortex fluctuations in two dimensional arrays of Josephson junctions. We find phase transitions which do not have the critical behavior expected from standard symmetry analyses. DOE

N93-17177# Los Alamos National Lab., NM.
THE LOCAL STRUCTURE OF HIGH-TEMPERATURE SUPERCONDUCTORS
J. MustredeLeon, S. D. Conradson, A. R. Bishop, and I. D. Raistrick 1992 6 p Presented at the 7th International Conference on X Ray Absorption Fine Structure, Kobe (Japan), 23-29 Aug. 1992
(Contract W-7405-eng-36)
(DE93-000653; LA-UR-92-3057; CONF-9208160-1) Avail: CASI HC A02/MF A01

We show how x-ray absorption fine structure (XAFS) has been successfully used in the determination of the local crystal structure of high-temperature superconductors, with advantages over traditional diffraction techniques. We review the experimental results that yielded the first evidence for an axial-oxygen-centered lattice instability connected with the superconductivity transition. The interpretation of this instability in terms of a dynamical tunneling model suggests the presence of polarons in these materials. XAFS on Tl2Ba2CuO6 and other Tl-based superconductors indicate the presence of local instabilities in the CuO2 planes of these materials, in addition to axial-oxygen instabilities. DOE

N93-17198# State Univ. of New York, Buffalo. Dept. of Physics and Astronomy.
X-RAY STUDIES OF MICROSTRUCTURES IN SEMICONDUCTORS AND SUPERCONDUCTING MATERIALS
Y. H. Kao Apr. 1992 17 p
(Contract DE-FG02-87ER-45283)
(DE93-001953; DOE/ER-45283/11) Avail: CASI HC A03/MF A01

The objective is to use synchrotron x rays to probe short-range-order (SRO) structures in these materials. These SRO structures, with a scale of a few angstroms, include these around interfaces in multilayers, strain and local environs around impurity or constituent atoms, as well as lattice mismatch, intermixing of atoms across interfaces, annealing, etc. A new soft x-ray detector has been built and was used to measure x-ray fluorescence from O and F in bulk materials. The research on microstructure in both semiconductors and high-T(sub c) superconductors is being continued with emphasis on multilayer materials. X-ray absorption fine structure spectroscopy is being used in many of the studies, as is grazing incidence x-ray fluorescence and scattering. Total electron yield is used with fluorescence to probe surfaces and interfaces. Effects of doping on superconducting properties, especially these related to microstructures around impurities or constituent atoms, were studied. Resulting papers are listed. DOE

N93-17206# Los Alamos National Lab., NM.
CRYSTALLOGRAPHIC AND MAGNETIC PROPERTIES OF UPdSn
S. W. Johnson, R. A. Robinson, Allen C. Larson, H. Nakotte (Amsterdam Univ., Netherlands), E. Brueck (Amsterdam Univ., Netherlands), and F. R. deBoer (Amsterdam Univ., Netherlands) 1992 12 p Presented at the Conference on Magnetism and Magnetic Materials, Houston, TX, 1-4 Dec. 1992 Submitted for publication
(Contract W-7405-eng-36)
(DE92-040243; LA-UR-92-2701; CONF-921201-1) Avail: CASI HC A03/MF A01

A single crystal of the intermetallic compound UPdSn was studied by means of neutron diffraction using the white-beam Laue diffractometer SCD at the Los Alamos spallation neutron source. Data were taken in the paramagnetic phase at 55 K and just below the Neel point at 37 K. The crystallographic data refine well within the space group P6(sub 3)mc and confirm the results obtained previously on powders, namely that the Pd and Sn atoms are ordered. At low temperature, UPdSn undergoes two phase transitions at 40 K and 25 K to complicated non-collinear antiferromagnetic structures. All three pairs of magnetic domains are observed, in roughly equal populations, in the intermediate-temperature orthorhombic magnetic structure (Phase 1). We obtain a uranium moment of 0.863 mu(sub B) and canting angles phi = 57.52 deg and theta = 18.63 deg, in reasonable agreement with previous powder neutron data for this temperature. The observed form factor is characteristic of the tetravalent f(sup 2) configuration. DOE

N93-17223# Rome Univ. (Italy). Dipt. di Fisica.
APICAL OXYGEN IONS AND THE ELECTRONIC STRUCTURE OF THE HIGH T(SUB c) CUPRATES
L. F. Feiner, M. Grilli, and C. DiCastro (Philips Gloeilampenfabrieken N.V., Eindhoven, Netherlands) 7 Oct. 1991 85 p
(Preprint-828; ETN-93-92931) Avail: CASI HC A05/MF A01

A five band extended Hubbard model involving four orbitals on the CuO2 planes of the high temperature superconducting oxides and the 2p(sub Z) orbital(s) for the out of plane apical oxygen ion(s) are analyzed. The strong local repulsion between holes on copper is treated by means of a slave boson approach in mean field approximation. The nearest neighbor Cu-O coulombic repulsion is studied within a Hartree decoupling scheme. The variation of the resulting band structure with doping and with varying model parameters is studied and its stability with respect to lattice deformations is examined. The results are compared with experimental data. The effects of the apical oxygen(s) on the electronic structure are analyzed and the amount of holes in states with local a(sub 1) symmetry is identified. An analysis of ten different classes of compounds reveals a correlation between the maximum critical temperature and the excess of a(sub 1) holes. This correlation indicates that the highest critical temperature can be reached in the compounds where the interaction between apical oxygen(s) and CuO2 plane is weakest. The implication of these results is discussed in the light of various theoretical models. ESA

N93-17226# Argonne National Lab., IL.
EFFECT OF SUBSTRATE-TWIN-INDUCED MICROSTRUCTURE ON TRANSPORT PROPERTIES OF EPITAXIAL Tl2Ba2CaCu2O(x) FILMS IN A MAGNETIC FIELD
D. H. Kim, D. J. Miller, J. D. Hettinger, K. E. Gray, P. G. Landis, J. E. Sharping, and M. Eddy (Superconducting Technology, Inc., Mountain View, CA.) Aug. 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE93-000605; ANL/CP-77431; CONF-920802-18) Avail: CASI HC A01/MF A01

The role of substrate-induced microstructure on transport properties in c-axis oriented epitaxial Tl2Ba2CaCu2O(x) films grown on LaAlO3 and SrTiO3 was studied. For a magnetic field parallel to the Cu-O planes, resistivity and the critical current density, J(sub c), were measured as a function of angle (theta) between the applied field and the direction of transport current. Resistivity dips and enhancement of the critical current density, J(sub c), were observed for magnetic fields applied parallel to the substrate twins in LaAlO3 in high fields (greater than or = 2 T). Meanwhile for films on SrTiO3, resistivity and J(sub c) were Lorentz-force independent. DOE

N93-17227# Argonne National Lab., IL.
ENHANCED SUPERCONDUCTING PROPERTIES IN Bi2Sr2Ca1Cu2O(y) BY THERMAL AND MECHANICAL PROCESSING
D. J. Miller, T. G. Holesinger, J. D. Hettinger, K. C. Goretta, and K. E. Gray Aug. 1992 5 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE93-000609; ANL/CP-77432; CONF-920802-22) Avail: CASI HC A01/MF A01

The practical application of high temperature superconductors has been limited by low transport currents in bulk samples. The effect of processing on transition temperature, grain boundary coupling, and flux pinning has been examined for Bi2Sr2CaCu2O(y). Enhancement of (Tc) based on composition can be achieved by control of crystallization and subsequent annealing processes while thermo-mechanical processing may be used to modify weak link and flux pinning behavior. The microstructural basis for these changes are related to the composition of the superconducting phase and the presence of defects associated with deformation processing. The implications of these results on conductor development are related to the selection of alloy composition for optimum transition temperature and controlled thermo-mechanical processing which yields a uniform defect structure. DOE

N93-17228# Los Alamos National Lab., NM.
TRANSPORT AND MAGNETIZATION CRITICAL CURRENT DENSITIES IN TlBa2Ca2Cu3O(x) TAPES
J. O. Willis, M. P. Maley, P. J. Kung, J. Y. Coulter, D. E. Peterson, P. G. Wahlbeck, J. F. Bingert, and D. S. Phillips 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-7405-eng-36)
(DE93-000651; LA-UR-92-3069; CONF-920802-17) Avail: CASI HC A01/MF A01

The powder in tube process was used to produce silver-sheathed tapes of TlBa2Ca2Cu3O(8+x) (Tl-1223). The powder was produced by thalliating a precursor powder mixture to produce the Tl-2223 phase and then beating to drive off excess Tl and reach the Tl-1223 stoichiometry. The tapes were rolled and pressed, each step followed with a 3 hr. sintering. The 200 micron thick tapes show little sign of texturing; however, the critical current shows a small (approximately 50 percent) dependence on the direction of the applied magnetic field. Both transport and magnetization measurents indicate relatively strong pinning at high temperatures. The 75 K self field critical current density is 62 MA/m(exp 2). Transport measurements reveal the presence of weak links at all temperatures, but with a relatively weak field dependence above approximately 0.1 T. DOE

N93-17342# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
POLYCRYSTALLINE THIN FILM MATERIALS AND DEVICES
B. N. Baron (Delaware Univ., Newark.), R. W. Birkmire (Delaware Univ., Newark.), J. E. Phillips (Delaware Univ., Newark.), W. N. Shafarman (Delaware Univ., Newark.), S. S. Hegedus (Delaware Univ., Newark.), and B. E. McCandless (Delaware Univ., Newark.) Oct. 1992 107 p
(Contract DE-AC02-83CH-10093)
(DE93-000022; NREL/TP-451-5094) Avail: CASI HC A06/MF A02

Phase 2 results of a research program on polycrystalline thin film heterojunction solar cells are presented. Relations between processing, materials properties, and device performance were studied. The analysis of these solar cells explains how minority carrier recombination at the interface and at grain boundaries can be reduced by doping of windows and absorber layers, such as in high efficiency CdTe and CuInSe2 based solar cells. The additional geometric dimension introduced by the polycrystallinity must be taken into consideration. The solar cells are limited by the diode current, caused by recombination in the space charge region. J-V characteristics of CuInSe2/(CdZn)S cells were analyzed. Current-voltage and spectral response measurements were also made on high efficiency CdTe/CdS thin film solar cells prepared by vacuum evaporation. Cu-In bilayers were reacted with Se and H2Se gas to form CuInSe2 films; the reaction pathways and the precursor were studied. Several approaches to fabrication of these thin film solar cells in a superstrate configuration were explored. A self-consistent picture of the effects of processing on the evolution of CdTe cells was developed. DOE

N93-17350# Ames Lab., IA.
PHASE EQUILIBRIA, SUPERCONDUCTIVITY, AND FLUX CREEP IN Nd(1+x)Ba(2-x)Cu3O(7+DELTA) SUPERCONDUCTORS Ph.D. Thesis
Sang-Im Yoo Sep. 1992 119 p
(Contract W-7405-eng-82)
(DE93-001223; IS-T-1613) Avail: CASI HC A06/MF A02

NdBa2CU3O7(Nd123) is one of REBa2CU3O7(RE123) superconductors (RE = Y and rare earths), having T(sub c) of about 90 K. The phase diagram in the Nd-Ba-Cu-O system, superconductivity in Nd123ss, and the role of Nd substitution for Ba sites as the magnetic flux pinning sites were investigated. The discrepancies in published phase diagrams were clarified. Significant results contain the solubility limits of 0.04 is less than or equal to x is less than or equal to 0.6 in Nd123ss, the existence of Nd2BaCuO10 having a solid solution, and a discovery of a new phase NdBa6CU3Oy. Superconductivity in Nd(1+x)Ba(2-x)CU3O(7+delta) was studied for well-characterized samples with sharp transitions. With the substitution of Nd(+3) for Ba(+2), there is an increase in the O(5) sites surrounding this substitution. While for x greater than 0.1 there is a significant depression of T(sub c), for x less than 0.1 there is no substantial decrease in T(sub c) within experimental error. T(sub c) vs x is characterized by two plateaus analogous to T(sub c) vs d in YBa2CU3O(7-d). Analysis of O content of Nd123ss suggests the analogy with Y123 is valid. Transition width and Meissner fraction for all Nd123ss samples are strongly dependent on the sintering temperature. Hysteresis show good intragranular critical currents (J(sub c)) at high fields but still low intergranular. Since the magnetic fields penetrate a Type II superconductor at high field, flux lines must be pinned to increase the J(sub c). While T(sub c) is not affected over the range 0 is less than x is less than 0.1, the oxygens surrounding the substituted Ba sites are expected to locally suppress the superconducting order parameter. Such a local suppression of the order parameter may act as a flux pinning site. Hysteresis exhibits a small increase in the magnetic J(sub c), but flux creep measurements show no apparent effects of this substitution on flux pinning energy. DOE

N93-17351# Ames Lab., IA.
DISTANCE ANALYSIS OF PATTERSON CALCULATIONS AND MOLECULAR MECHANICS AS AIDS IN STRUCTURE SOLUTION Ph.D. Thesis
C. L. Day Sep. 1992 142 p
(Contract W-7405-eng-82)
(DE93-001224; IS-T-1620) Avail: CASI HC A07/MF A02

Two methods (SUPSYMM and MMXRAY) for crystal structures insoluble through normal crystallography were developed. SUPSYMM needs only a list of Patterson superposition peaks as its starting point. Using distance analysis and vector projections, symmetry relations between the superposition peaks are identified which are exploited to identify probable peak positions for least-squares refinement. MMXRAY solves large organometallic structures by using Patterson superposition and molecular mechanics. Patterson superposition techniques can usually locate at least the heavy atoms. Molecular mechanics is used to model the remaining organic parts of the structure. MMXRAY converts the modeled structure to the original crystallographic reference system. Two programs designed to teach the basics of both powder and single crystal X-ray diffraction methods to undergraduate physical chemistry students are presented in the Appendix. Several crystal structures solved through routine crystallographic routes are also discussed. DOE

N93-17357# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
LOCAL CRITICAL CURRENT MEASUREMENTS ON (Bi,Pb)2Sr2Ca2Cu3O(SUB x) TAPE WITH AN ELECTROMAGNETIC PROBE
K. L. Telschow (Idaho National Engineering Lab., Idaho Falls.), T. K. OBrien

(Idaho National Engineering Lab., Idaho Falls.), M. T. Lanagan, and D. Y. Kaufman 24 Aug. 1992 5 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contracts W-31-109-eng-38; DE-AC07-76ID-01570)
(DE92-041133; ANL/CP-77169; EGG-M-92184; CONF-920802-11) Avail: CASI HC A01/MF A01

The ability to measure critical currents in high T(sub c) superconducting tapes on a local scale is valuable for optimizing the fabrication process. This paper describes the use of induced currents from a small noncontacting electromagnetic probe to determine the critical current density in a (Bi,Pb)2Sr2Ca2Cu3O(x)/Ag tape on a local scale. The technique forces full field penetration into the tape locally and infers the critical current density from the Bean critical state model, accounting for the Ag overlayers. Critical current images of the tape can be obtained by scanning the probe over the tape surface with spatial resolution on the order of 1.0 mm. Results for tapes with different microstructures are discussed. DOE

N93-17365# Los Alamos National Lab., NM.
MICROSTRUCTURAL AND ELECTRONIC PROPERTIES OF HIGHLY ORIENTED Tl(0.5)Pb(0.5)Sr2CaCu2O7 FILMS ON LaALO3
D. J. Kountz, P. L. Gai, C. Wilker, W. L. Holstein, F. M. Pellicone, and R. J. Brainard 1992 5 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-7405-eng-36)
(DE93-000655; LA-UR-92-3054; CONF-920802-16) Avail: CASI HC A01/MF A01

Epitaxial Tl(0.5)Pb(0.5)Sr2CaCu2O7 films produced by rf magnetron sputtering followed by annealing in the presence of thallium oxide vapor have been produced on (100) LaAlO3 substrates. These films are highly c-axis oriented with rocking curve full width at half maximum less than 0.4 degrees. The resulting two copper oxide layer films exhibit microwave surface resistance at 10 GHz of 60 +/- 3 micro-ohms at 4.2 K and 498 +/- 10 micro-ohms at 70 K (T(sub c) = 88 +/- 2 K). The degree of lattice mismatch between this phase and the LaAlO3 substrate is very small resulting in epitaxial thin films. This material exhibits very little intrinsic defect structure. DOE

N93-17368# Oak Ridge National Lab., TN.
STABLE ISOTOPE ENRICHMENT: CURRENT AND FUTURE POTENTIAL
J. G. Tracy and W. S. Aaron 1992 17 p Presented at the 16th World Conference of the International Nuclear Target Development Society: Nuclear Target Preparation, Legnaro, Italy, 21-25 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE92-041258; CONF-920933-1) Avail: CASI HC A03/MF A01

Oak Ridge National Laboratory (ORNL) operates the Isotope Enrichment Facility for the purpose of providing enriched stable isotopes, selected radioactive isotopes (including the actinides), and isotope-related materials and services for use in various research applications. ORNL is responsible for isotope enrichment and the distribution of approximately 225 nongaseous stable isotopes from 50 multi-isotopic elements. Many enriched isotope products are of prime importance in the fabrication of nuclear targets and the subsequent production of special radionuclides. State-of-the-art techniques to achieve special isotopic, chemical, and physical requirements are performed at ORNL. This report describes the status and capabilities of the Isotope Enrichment Facility and the Isotope Research Materials Laboratory as well as emphasizing potential advancements in enrichment capabilities. DOE

N93-17376# Argonne National Lab., IL.
DESIGN AND MODELING OF SUPERCONDUCTING RFQ STRUCTURES
J. R. Delayen and W. L. Kennedy 1992 3 p Presented at the 16th International LINAC Conference, Ottawa, Ontario, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE93-000511; ANL/CP-77442; CONF-9208109-65) Avail: CASI HC A01/MF A01

Tests of the first superconducting RFQ structure indicated that high surface electric fields could be sustained in a quadrupole geometry. However, the geometry used in those tests was not appropriate for an accelerating structure and the area sustaining the high electric field was too small to assume that such fields could be achieved in actual RFQ structures. We have initiated a program to analyze and model a variety of geometries suitable for superconducting RFQ structures. We are also designing a niobium RFQ 'sparker' to experimentally measure the surface electric fields that can be achieved on large areas in an actual RFQ structure. DOE

N93-17377# Argonne National Lab., IL.
DESIGN AND TEST OF A SUPERCONDUCTING STRUCTURE FOR HIGH-VELOCITY IONS
J. R. Delayen, W. L. Kennedy, and C. T. Roche 1992 3 p Presented at the 16th International LINAC Conference, Ottawa, Ontario, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE93-000513; ANL/CP-77443; CONF-9208109-64) Avail: CASI HC A01/MF A01

Following the successful development of a niobium coaxial half-wave structure we have designed, built and tested a new half-wave geometry: the spoke resonator. This geometry is better suited for high frequency resonators and for the acceleration of high velocity ions. The prototype cavity is a 2-gap structure resonating at 855 MHz, and optimized for particle velocity of 0.30 c. It is easier to manufacture than the coaxial half-wave resonator and the geometry can be straightforwardly extended to multigap designs. Rf-tests have been performed on this cavity both prior to and after high temperature annealing. An accelerating gradient of 7.2 MV/m (cw) and 7.8 MV/m (pulsed) was observed at 4.2 K. After annealing, a low power Q(sub 0) of 1.2 x 10(exp 8) was observed with small Q degradation due to field emission at high accelerating fields. DOE

N93-17378# Argonne National Lab., IL.
SIMULATED HIGH HEAT LOAD PERFORMANCE OF AN INCLINED CRYSTAL MONOCHROMATOR
A. T. Macrander, A. M. Khounsary, and M. Graham Sep. 1992 13 p Presented at the Society of Photo-Optical Instrumentation Engineers International Symposium on Optical Applied Science and Engineering, San Diego, CA, 19-24 Jul. 1992
(Contract W-31-109-eng-38)
(DE93-000506; ANL/CP-77394; CONF-920792-34) Avail: CASI HC A03/MF A01

Thermal distortions of an inclined silicon crystal subjected to the high heat loads expected for a 2.5 m long undulator at the Advanced Photon Source were simulated, and the distortions were then used to calculate (111), (111) (+,-) double crystal rocking curves. The inclination angle for all the simulations was either 80 degree or 85 degree. The first crystal was assumed to be a slab that was uniformly cooled on its underside with liquid gallium. For some of the simulations, the undulator gap was set to 11.5 mm corresponding to K = 2.2 and the crystals were oriented to diffract the first harmonic energy at 4.2 keV. For K = 2.2, the total x-ray power incident on the crystal is 3.8 kW, and the peak power density transverse to the beam is 148 W/sq mm. Rocking curve broadening in these cases was found to be no more than 0.42 arcsec. Simulations for the third harmonic at K = 2.2 were also performed, and the broadening was found to be no more than 1.87 arcsec. In other simulations the undulator gap was widened, and rocking curves for the third harmonic at K = 1.5 (19.9 key) and the first harmonic at K = 1.2 (8.2 keV) were obtained. Only weak broadening was found for these cases as well. Finally, rocking curves at 4.2 keV were not altered if a slit that passed only the central cone of the undulator was placed in front of the first crystal. DOE

N93-17391# Brookhaven National Lab., Upton, NY.
MULTILAYER MONOCHROMATORS AND SUPERMIRRORS FOR NEUTRON PROTEIN CRYSTALLOGRAPHY USING A QUASI LAUE TECHNIQUE
B. P. Schoenborn 1992 7 p Presented at the Society of Photo-Optical Instrumentation Engineers International Symposium on Optical Applied Science and Engineering, San Diego, CA, 19-24 Jul. 1992
(Contract DE-AC02-76CH-00016)
(DE93-001654; BNL-47954; CONF-920792-38) Avail: CASI HC A02/MF A01

The major problem in neutron protein crystallography is the low flux of present neutron sources. The collection of a data set using a conventional rotation technique and a 2D detector takes many weeks. One way to increase the flux at the sample is to increase the wavelength bandwidth. The conventional technique using a standard monochromator like Cu or

Be has a typical bandwidth of 1 percent. A multilayer monochromator can however be tailored to give bandwidth up to 25 percent or even larger and have an angular acceptance angle of approximately 3 percent. This can be achieved by a multiple spacing multilayer. In this case the diffraction geometry is such that the reflection in diffraction condition is 'scanned' by the Delta lambda and not by rotating the reciprocal lattice point through the Ewald sphere. Wavelength bandwidth of 10 percent satisfy this condition. It is important to tailor the bandwidth to the size needed by the extend of the reciprocal lattice 'point' to minimize background. The intensity of the reflection is proportional to the Delta lambda r that just covers the width of the reciprocal 'point' while the background is proportional to the full wavelength spread (Delta)(lambda) that hits the crystal. The conventional Laue technique is not suitable since it increases the background by the ratio of Delta lambda Delta lambda r, a ratio that can easily reach multiples of 10. DOE

N93-17413*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

PROCESS FOR THE CONTROLLED GROWTH OF SINGLE-CRYSTAL FILMS OF SILICON CARBIDE POLYTYPES ON SILICON CARBIDE WAFERS Patent Application

David J. Larkin, inventor (to NASA) and J. Anthony Powell, inventor (to NASA) 9 Nov. 1992 23 p

(NASA-Case-LEW-15222-3; NAS 1.71:LEW-15222-3; US-Patent-Appl-SN-973505) Avail: CASI HC A03/MF A01

A method for the controlled growth of single-crystal semiconductor-device-quality films of SiC polytypes on vicinal (0001) SiC wafers with low tilt angles is presented. Both homoepitaxial and heteroepitaxial SiC films can be produced on the same wafer. In particular, 3C-SiC and 6H-SiC films can be produced within selected areas of the same 6H-SiC wafer. NASA

N93-17476# Ames Lab., IA.

THE CHARACTERIZATION OF ORGANIC MONOLAYERS AT GOLD SURFACES USING SCANNING TUNNELING MICROSCOPY AND ATOMIC FORCE MICROSCOPY CORRELATION WITH MACROSTRUCTURAL PROPERTIES Ph.D. Thesis

C. A. Alves Sep. 1992 193 p

(Contract W-7405-eng-82)

(DE93-001218; IS-T-1628) Avail: CASI HC A09/MF A03

Monolayer films formed by self-assembly of organothiols at epitaxially grown Au(111) films at mica were examined in air using scanning tunneling (STM) and atomic force microscopies (AFM). n-Alkanethiolate monolayers exhibit a hexagonal packing arrangement with nearest-neighbor and next-nearest-neighbor spacings of 0.50 and 0.87 nm. This arrangement is consistent with (the square root of 3 x the square root of 3)R30 deg adlayer structure at Au(111). STM reveals the structure of the Au-bound sulfur, while AFM details the structure at the monolayer/air interface, revealing that the order at the Au-S interface is retained up to the monolayer/air interface. The investigation of the self-assembled (CF3CF2)7(CH2)2SH monolayer at Au(111) by AFM reveals a (2 x 2) adlayer structure, with nearest-neighbor and next-nearest-neighbor spacings of 0.58 plus or minus 0.02 nm and 1.0 plus or minus 0.02 nm, respectively. This is consistent with the larger van der Waals diameter of the fluorinated chain. Coverage of this fluorinated thiolate monolayer is (6.3 plus or minus 0.8) x 10(exp -10) mol/cm(sup 2), consistent with the expected 0.25 monolayer coverage of the (2 x 2) adlayer structure at Au(111). Infrared reflection spectroscopy also confirmed this. Upon prolonged exposure to air, the thiolate species is oxidized to elemental sulfur in the forms of cyclooctasulfur (cyclo-S8) and other allotropes. STM reveals square structures on aged thiolate monolayers. Dimensions of these squares (0.40-0.50 nm per side) are close to those of cyclo-S8. Electrochemical reductive desorption experiments also reveal a change in the surface species with time, with a second desorption wave. DOE

N93-17492# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).

CONCEPTION AND MOLECULAR BEAM EPITAXIAL GROWTH OF (Ga,Al)As-(Ca,Sr)F2 MULTILAYERS FOR OPTICAL APPLICATION Ph.D. Thesis - Toulouse Univ.

Philippe Requena 1991 137 p In FRENCH

(LAAS-91306; ETN-92-92547) Avail: CASI HC A07/MF A02

The conception and molecular beam epitaxy growth of multilayer structures for optics, involving GaAs, (Ga,Al)As semiconductors, and (Ca,Sr)F2 fluorides are addressed. The structures studied are Bragg reflectors and interference filters. The theoretical and experimental tools used for conceiving, growing, and characterizing the structures are described. The method for calculating the reflectance spectra of the multilayers is detailed. The calculation takes into account the effect of an applied electric field. The molecular beam epitaxy system, the experimental conditions used for growing the structures, the set up for optical characterization, and the technological processes developed are presented. Good optical and mechanical properties of (Ga,Al)As-(Ca,Sr)F2 reflectors were obtained by using a geometry based on the generalization of the standard Bragg geometry. Interference filters including these reflectors are designed in view of application to electrooptical modulation. The feasilbility of these devices is discussed in terms of the sensitivity of their optical performances to growth conditions. ESA

N93-17561# Oak Ridge National Lab., TN.

SOLID STATE DIVISION PROGRESS REPORT, PERIOD ENDING 31 MARCH 1992

P. H. Green, ed. and L. W. Hinton, ed. Sep. 1992 270 p

(Contract DE-AC05-84OR-21400)

(DE93-003665; ORNL-6722) Avail: CASI HC A12/MF A03

During this period, the division conducted a broad, interdisciplinary materials research program with emphasis on theoretical solid state physics, superconductivity, neutron scattering, synthesis and characterization of materials, ion beam and laser processing, and the structure of solids and surfaces. The High Flux Isotope Reactor was returned to full operation. DOE

N93-17563# Technische Univ., Delft (Netherlands). Electrical Materials Lab.

MINORITY CARRIER TRANSPORT IN HEAVILY DOPED SILICON Ph.D. Thesis

Yang Pan 1992 146 p

(Contract IC-DEL88-032)

(ETN-92-92527) Avail: CASI HC A07/MF A02

The physics of minority carrier transport in heavily doped regions of small bipolar transistors is investigated. Minority carrier transport in heavily doped quasi neutral regions can be modeled by two coupled differential equations of the first order including the effects of density of states distortion. The energy dependent mobility and lifetime are incorporated into the transport equations. The quantum mechanical tail model is simplified by an empirical exponential expression. Densities of states, for both conduction and valence bands, are derived from photoluminescence spectra. At room temperatures, the presence of band tails in both bands increases the equilibrium minority carrier concentration by a factor of two. For modeling of very small bipolar transistors, classical macroscopic models cannot be used. The fluctuation in the base current was studied by using the two dimensional ensemble Monte Carlo technique. The most important result is that the fluctuation in the minority carrier current is a limitation for scaling bipolar transistors. The minority hole transport parameters were measured in highly doped emitters. A numerical method to solve the inhomogeneous profile problem was developed. The transport parameters were measured on doped arsenic. No lifetime degradation in arsenic implanted layers was observed. This suggests a controlled annealing process and gettering, expected to remove most of the defects from the emitters. ESA

N93-17651# Lawrence Livermore National Lab., CA.

MAGNETIC CIRCULAR DICHROISM IN X RAY ABSORPTION AND CORE-LEVEL PHOTOEMISSION OF Fe/Cu(001)

J. G. Tobin, G. D. Waddill, and D. P. Pappas Jul. 1992 4 p Presented at the 10th International Conference on Vacuum Ultraviolet Radiation Physics, Paris, France, 27-31 Jul. 1992

(Contract W-7405-eng-48)

(DE93-001305; UCRL-JC-108837; CONF-920735-4) Avail: CASI HC A01/MF A01

We report the first observation of magnetic circular dichroism in both x-ray absorption and core-level photoemission of ultra thin magnetic films using circularly polarized x-rays. Iron films (1-4 ML) grown on a Cu(001,) substrate at 150 K and magnetized perpendicular to the surface show dramatic changes in the L(sub 2,3) branching ratio for different x-ray

polarizations. For linearly-polarized x-rays perpendicular to the magnetic axis of the sample the branching ratio was 0.75. For films greater than or equal to 2 ML, this ratio varied from 0.64 to 0.85 for photon spin parallel and anti-parallel, respectively, to the magnetic axis. This effect was observed either by changing the x-ray helcity for a fixed magnetic axis, or by reversing the magnetic axis for a fixed x-ray helicity. Our observation can be analyzed within a simple one-electron picture, if the raw branching ratios are normalized so that the linear value becomes statistical. Furthermore, warming the films to approximately 300 K eliminated this effect, indicating a loss of magnetization in the film over a temperature range of approximately 30 K. Finally, reversing the relative orientation of the photon spin and the magnetic axis from parallel to anti-parallel allowed measurement of the exchange splitting of the Fe 2p core levels which was found to be approximately 0.2 eV. These results are consistent with earlier studies, but the use of off-plane circularly-polarized x-rays from a bending magnet monochromator offers approximately 2 orders of magnitude greater intensity than typical spin-polarization measurements. DOE

N93-17652# Pacific Northwest Lab., Richland, WA.
ION-BEAM MODIFICATION OF Gd2Ti2O7
W. J. Weber and N. J. Hess Sep. 1992 16 p Presented at the 8th International Conference on Ion Beam Modification of Materials, Heidelberg, Germany, 7-11 Sep. 1992
(Contract DE-AC06-76RL-01830)
(DE93-001514; PNL-SA-20885; CONF-9209200-6) Avail: CASI HC A03/MF A01

Irradiation of Gd2Ti2O7 with 3 MeV Ar(+) ions results in expansion of the unit-cell volume from defect accumulation as well as irradiation-induced amorphization. The damage cross-section for amorphization determined from X-ray diffraction analysis is 0.023 nm(exp 2). Transmission electron microscopy and electron diffraction have confirmed the irradiation-induced amorphous character at high fluences. Raman spectroscopy indicates a decrease in scattered intensity and an increase in linewidth with fluence for the principal vibrational modes, consistent with increasing irradiation-induced disorder. The wavenumber of the most intense Raman peak at approximately 310 cm(exp -1) (attributed to the O-Gd-O bending mode) decreases with fluence, indicating a change in bond Angle. The increase in the wavenumber of the Raman peak at approximately 515 cm(exp -1) (attributed to the Gd-O stretching mode) with fluence suggests a decrease in bone length. At intermediate fluences, a forbidden peak at 765 cm(exp -1) becomes slightly activated by irradiation-induced disorder on the cation sites. DOE

N93-17688# Massachusetts Inst. of Tech., Cambridge. Welding Lab.
MAGNETOSTATIC WAVE TECHNOLOGY Final Report, Oct. 1986 - Sep. 1990
A. R. Calawa and R. A. Murphy Jun. 1992 41 p
(Contract F19628-85-C-0002)
(AD-A257723; RL-TR-92-173) Avail: CASI HC A03/MF A01

The integration of GaAs with ferrimagnetic garnets was investigated and demonstrated. A hybrid technique was first used to integrate two GaAs circuits with yttrium-iron garnet (YIG) delay lines, demonstrating the feasibility and benefits of combining the two materials in special microwave operations. The epitaxial growth of single-crystal GaAs on gadolinium-gallium garnet (GGG) was then accomplished, demonstrating a first step in the monolithic integration of the two materials. The hybrid circuit, consisting of a GaAs microwave circuit integrated with a tapped YIG delay line, formed an oscillator with an extremely short external delay loop, and taps provided multiple outputs with long delay times. The oscillator was tunable from 2.76 to 2.95 GHz with a 3-dB bandwidth of 1OkHz. The first growth of GaAs on GGG was successfully performed by using an InAs buffer layer and an InAs/GaAs multilayer structure between the GGG and the GaAs. The unintentionally doped InAs layers were n-type with room-temperature donor concentrations in the range of 7 x 10(exp 16) to 2 x 10(exp 18) cm(exp -3), and corresponding mobilities were 3.5 x 10(exp 3) to 1 x 10(exp 3) sq cm/V s. Hall measurements indicated that the GaAs was conducting. These were the first electrical measurements ever reported for any III-V compound semiconductor deposited on a garnet. GRA

N93-17754# Lehigh Univ., Bethlehem, PA.
THE 16TH INTERNATIONAL CONFERENCE ON DEFECTS IN SEMICONDUCTORS Final Report, 1 May 1991 - 30 Apr. 1992
M. Stavola and G. DeLeo 30 Apr. 1992 328 p Conference held in Bethlehem, PA, 22-26 Jul. 1991
(Grant AF-AFOSR-0217-91)
(AD-A258035; Lehigh-429054) Avail: CASI HC A15/MF A03

This report consists of the abstracts for the 16th International Conference on Defects in Semiconductors held at Lehigh University, Bethlehem, PA on July 22-26, 1991. Approximately 250 papers were presented. This meeting addressed the fundamental science of imperfection in semiconductor materials. A wide range of defects of both fundamental and technological interest that include native defects, impurities, dislocations, and defects at surfaces and interfaces in a variety of semiconductor materials (Si, Ge, diamond, III-V and II-VI compounds, and related alloys) were discussed. Properties of interest included defect structures (atomic and electronic), defect introduction, reactions, motion, electrical and optical characteristics, etc. The following are a few examples of recent work that is breaking new ground in the field: (1) oxygen in GaAs has been identified recently and has metastable characteristics; and (2) after many years of effort, there has been progress in the doping of II-VI materials. GRA

N93-17788# Florida State Univ., Tallahassee.
He ATOM SURFACE SCATTERING: SURFACE DYNAMICS OF INSULATORS, OVERLAYERS AND CRYSTAL GROWTH
1992 28 p
(Contract DE-FG05-85ER-45208)
(DE93-002788; DOE/ER-45208/8) Avail: CASI HC A03/MF A01

Investigations have focused primarily on surface structure and dynamics of ionic insulators, epitaxial growth onto alkali halide crystals and multiphoton studies. The surface dynamics of RbCl has been re-examined. We have developed a simple force constant model which provides insight into the dynamics of KBr overlayers on NaCl(001), a system with a large lattice mismatch. The KBr/NaCl(001) results are compared to Na/Cu(001) and NaCl/Ge(001). We have completed epitaxial growth experiments for KBr onto RbCl(001). Slab dynamics calculations using a shell model for this system with very small lattice mismatch are being carried out in collaboration with Professor Manson of Clemson University and with Professor Schroeder in Regensburg, Germany. Extensive experiments on multiphoton scattering of helium atoms onto NaCl and, particularly, LiF have been carried out and the theory has been developed to a rather advanced stage by Professor Manson. This work will permit the extraction of more information from time-of-flight spectra. It is shown that the theoretical model provides a very good description of the multiphoton scattering from organic films. Work has started on self-assembling organic films on gold (alkyl thiols/Au(111)). We have begun to prepare and characterize the gold crystal; one of the group members has spent two weeks at the Oak Ridge National Laboratory learning the proper Au(111) preparation techniques. One of our students has carried out neutron scattering experiments on NiO, measuring both bulk phonon and magnon dispersion curves. DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N93-15940# Florida Univ., Gainesville. Dept. of Physics.
MODE ANALYSIS AND WARD IDENTITIES FOR PERTURBATIVE QUANTUM GRAVITY IN DE SITTER SPACE
N. C. Tsamis (Crete Univ., Iraklion, Greece) and R. P. Woodard Jun. 1992 12 p
(Contract DE-FG05-86ER-40272)
(DE92-040503; DOE/ER-40272/167; UFIFT-HEP-92-20) Avail: CASI HC A03/MF A01

We study linearized gravitons on the D-dimensional open submanifold spanned by de Sitter conformal coordinates. The physical modes are found in the same way as for flat space by imposing exact gauge conditions on the invariant field equations and then exploiting the residual gauge freedom of solutions. The resulting polarization tensors have vanishing zero

components and are transverse and traceless, just as in flat space. We also show that vacua exist such that the ghost and graviton propagators obey the Ward identity relating them. DOE

N93-15943# Florida Univ., Gainesville. Dept. of Physics.
CLASSICAL FLUIDS OF NEGATIVE HEAT CAPACITY
P. T. Landsberg (Southampton Univ., England) and R. P. Woodard Jun. 1992 13 p
(Contract DE-FG05-86ER-40272)
(DE92-040507; DOE/ER-40272/166; UFIFT-HEP-92-18) Avail: CASI HC A03/MF A01

It is shown that new parameters X can be defined such that the heat capacity C(sub X) (equivalent to) T(partial derivative of S/partial derivative of T)X is negative, even when the canonical ensemble (i.e. at fixed T = (partial derivative of U/partial derivative of S) and Y not equal to X) is stable. As examples we treat black body radiation and general gas systems with nonsingular kappa(sub T). For the case of a simple ideal gas we even exhibit an apparatus which enforces a constraint X(p,V) = const. that makes C(sub X) less than 0. Since it is possible to invent constraints for which canonically stable systems have negative heat capacity, we speculate that it may also be possible to infer the statistical mechanics of canonically unstable systems - for which even the traditional heat capacities are negative - by imposing constraints that stabilize the associated, inoncanonical ensembles. DOE

N93-15971# Mound Lab., Miamisburg, OH.
A GUIDE TO AUTOMATION TECHNIQUES IN CALORIMETRY
D. P. Renz, J. R. Wetzel, K. L. Breakall, S. J. James, and P. W. Kasperski 3 Sep. 1992 16 p
(Contract DE-AC04-88DP-43495)
(DE92-040948; MLM-3761) Avail: CASI HC A03/MF A01

The improvements that have occurred in calorimetry measurement technology in the past few years will help current users of calorimeters to achieve better use of their existing systems. These include a more user-friendly operator-computer interface, a more detailed printout at the end of each run, improved data processing to eliminate operator error, and improved system monitoring to detect system or environmental problems. In addition, an electrical calibration heater was developed to replace plutonium-238 heat standards for calibrating calorimeters, and several automation systems allow for easier and safer system operation. DOE

N93-15980# Naval Postgraduate School, Monterey, CA.
OPTIMIZATION OF AN INTERNALLY FINNED ROTATING HEAT PIPE M.S. Thesis
Geraldine L. Olson Jun. 1992 72 p
(AD-A256725) Avail: CASI HC A04/MF A01

A finite element formulation with linear triangular elements was used to solve the steady-state, two-dimensional conduction heat transfer equation in the condenser wall section of an internally finned rotating heat pipe. A FORTRAN program using this method was coupled with the ADS program for automated design of the internal heat pipe fin geometry to optimize heat transfer. An increase in surface area, which increases heat transfer, also increases the condensate level, which decreases heat transfer. The additional condensate level does not offset the advantage gained by the increased surface area. The investigation provided combinations of fin half angle, number of fins, and fin height for an optimum design. Water is used as the working fluid and the heat pipe is constructed from copper. GRA

N93-16242# National Inst. of Standards and Technology, Gaithersburg, MD.
THERMOPHYSICAL PROPERTIES
R. F. Kayser Jul. 1992 52 p
(Contract DE-FG02-91CE-23810)
(DE93-000493; DOE/CE-23810/3A) Avail: CASI HC A04/MF A01

Numerous fluids have been identified as promising alternative refrigerants, but much of the information needed to predict their behavior as pure fluids and as components in mixtures does not exist. In particular, reliable thermophysical properties data and models are needed to predict the performance of the new refrigerants in heating and cooling equipment, and to design and optimize equipment to be reliable and energy efficient. The objective is to provide highly accurate, selected thermophysical properties data for Refrigerants 32, 123, 124, and 125, and to use these data to fit simple and complex equations of state and detailed transport property models. The new data will fill gaps in the existing data sets and resolve the problems and uncertainties that exist in and between the data sets. DOE

N93-16357# California Univ., San Diego, La Jolla.
THEORETICAL PARTICLE PHYSICS
30 Sep. 1992 16 p
(Contract DE-FG03-90ER-40546)
(DE93-000649; DOE/ER-40546/T2) Avail: CASI HC A03/MF A01

This report discusses the following topics: heavy quark physics; Chiral Perturbation theory; Skyrmions; quarkonia and nuclear matter; parity violating nuclear matrix elements; how precisely can one determine M(sub U)/M(sub D); weak scale baryogenesis; constraints of baryogenesis form neutrino masses; majorons, double beta decay, supernova 1987A; rare decays; chiral lattice fermions; Pauli-Villars regulator and the Higgs mass bound; and Higgs and Yukawa interactions. DOE

N93-16639# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
QUANTUM MECHANICS AND POLARIZATION CORRELATIONS FOR PHOTONS
J. W. deRoever and M. Streng Feb. 1992 13 p
(MEMO-1035; ETN-92-92463) Avail: CASI HC A03/MF A01

An argument that both the satisfaction and the violation of the Bell inequalities have a quantum mechanical explanation is presented. The study concerns polarization correlation between two photons emitted by a common source. It is generally believed that experiments involving these correlations have shown that: the quantum mechanics was right; there is no signal faster than light. In the Copenhagen interpretation, where for 'quantum mechanics' one should read 'discrimination of our knowledge', the second statement is trivial because nobody can transfer knowledge faster than light. As to the first statement, it is explained that in the theory a choice concerning the way to describe these correlations has been made, which can only be justified by experiments. So it is not right to speak about the quantum mechanics. The two possibilities are compared. It is argued that in quantum mechanics alone, a reason to prefer the one above the other cannot be found. The only way to decide is to be convinced by experiments. ESA

N93-16648# National Lab. for High Energy Physics, Tsukuba (Japan).
RENORMALIZATION GROUP IN DIFFERENT FIELDS OF THEORETICAL PHYSICS
D. V. Shirkov (Joint Inst. for Nuclear Research, Dubna, USSR) Feb. 1992 87 p
(DE92-556707; KEK-91-13) Avail: CASI HC A05/MF A01

A very simple and general approach to the symmetry that is widely known as a Renormalization Group symmetry is presented. It essentially uses a functional formulation of group transformations that can be considered as a generalization of self-similarity transformations well known in mathematical physics since last century. This generalized Functional Self-Similarity symmetry and corresponding group transformations are discussed first for a number of simple physical problems taken from diverse fields of classical physics as well as for QED. Then we formulate the Renorm-Group Method as a regular procedure that essentially improves the approximate solutions near the singularity. After that we discuss relations between different formulations of Renormalization Group as they appear in various parts of a modern theoretical physics. Finally we present several topics of RGM application in modern QFT. DOE

N93-16960# Rome Univ. (Italy). Dipt. di Fisica.
A CONTINUUM STRING MODEL FOR D GREATER THAN 1
M. Martellini (Istituto Nazionale di Fisica Nucleare, Rome, Italy), M. Spreafico (Milan Univ., Italy), and K. Yoshida (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 8 Jan. 1992 14 p
(Preprint-853; ETN-93-92955) Avail: CASI HC A03/MF A01

The non critical string (two dimensional gravity coupled to the matter with central charge D) is quantized taking care of both diffeomorphism and Weyl symmetries. In incorporating the gauge fixing with respect to the Weyl symmetry, through the condition R(sub g) = const, one modifies the classical result of Distler and Kawai. The real string tension for an arbitrary value of central charge D is obtained. ESA

N93-16961# Rome Univ. (Italy). Dipt. di Fisica.
THE 2 + 1 DIMENSIONAL QUANTUM GRAVITY AS A GAUSSIAN FERMIONIC SYSTEM AND THE 3D-ISING MODEL
Giuseppe Bonacina (Milan Univ., Italy), Maurizio Martellini (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and Mario Rasetti (Politecnico di Torino, Italy) 15 Jan. 1992 37 p
(Preprint-855; POLFIS-TH18-91; ETN-93-92957) Avail: CASI HC A03/MF A01

The aim of the study is to show that 2 + 1 dimensional Euclidean quantum gravity is equivalent, under topological assumptions, to a Gaussian fermionic system. For manifolds topologically equivalent to (sigma(sub g)) times the set R of real numbers, with (sigma(sub g)) a closed and oriented Riemann surface of genus g, the coresponding 2 + 1 dimensional Euclidean quantum gravity may be related to the three dimensional lattice Ising model before its thermodynamic limit. ESA

N93-16963# Rome Univ. (Italy). Dipt. di Fisica.
NON-LINEAR WKB ANALYSIS OF THE STRING EQUATION
F. Fucito (Tor Vergata Univ., Rome, Italy), A. Gamba (Milan Univ., Italy), M. Martellini (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and O. Ragnisco (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 28 Jan. 1992 30 p
(Preprint-862; ETN-93-92964) Avail: CASI HC A03/MF A01

Nonlinear WKB analysis is applied to the study of the string equation. The solutions obtained with this method are not exact. However, they approximate extremely well the true solutions, as explicitly shown using numerical simulations. 'Physical' solutions are seen to be separatrices corresponding to degenerate Riemann surfaces. An analytic approximation, in agreement with the numerical solution found by Parisi et al. for the k = 3 case, is obtained. The following topics are presented: the Whitham method; the Painleve type 1 equation; and degenerate solutions. ESA

N93-16965# Rome Univ. (Italy). Dipt. di Fisica.
INTERACTING EUCLIDEAN THREE-DIMENSIONAL QUANTUM GRAVITY
Giuseppe Bonacina (Milan Univ., Italy), Andrea Gamba (Milan Univ., Italy), and Maurizio Martellini (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 25 Feb. 1992 22 p
(Preprint-867; IFUM-400/FT; ETN-93-92967) Avail: CASI HC A03/MF A01

The purpose of the study is to show that Euclidean three dimensional gravity coupled to a Gaussian scalar massive matter field in first order dreibein formalism gives a quantum theory which has a finite perturbative expansion around a nonvanishing background. A possible mechanism to generate a nontrivial background metric starting from some gauge invariant and diff-invariant nonlocal observables of the pure topological theory is discussed. These observables and their algebra were introduced by Rovelli and Smolin in the frame of Ashtekar's reformulation of canonical four dimensional general relativity and specialized to the case of 2 + 1 dimensional Einstein gravity. ESA

N93-16991# Rome Univ. (Italy). Dipt. di Fisica.
QUANTIZED ALGEBRAS, FIELD THEORY, AND DEFORMED GOLDSTONE BOSONS
S. Meljanac (Zagreb Univ., Yugoslavia) and S. Pallua (Trieste Univ., Italy) 29 Oct. 1991 14 p
(Preprint-836; INFN-AE-9114; ETN-93-92939) Avail: CASI HC A03/MF A01

A field theory with a deformed sl(2) internal symmetry is constructed for the simple case of a scalar complex field. Among other properties, the spontaneous breakdown is found to break the mass degeneracy, keeping nonvanishing masses that tend to Goldstone bosons in the classical symmetry limit. This theory can be regarded as an sl(2)(sub q) = 1 theory with operators delta J less than or equal to 2 breaking the usual symmetry. The deformed symmetry does not require identity of the particles involved. Two cases are considered: in one the full Lagrangian is sl(2)(sub q) invariant and in the other only the potential is invariant. The results show that spontaneous violations of sl(2)(sub q) break the degeneracy of the masses and that a class of field theories, invariant under deformed symmetries, can be defined. ESA

N93-17019# Rome Univ. (Italy). Dipt. di Fisica.
FLUCTUATIONS AND THERMODYNAMIC VARIABLES IN MEAN FIELD SPIN GLASS MODELS
Francesco Guerra (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 30 Apr. 1992 21 p Sponsored in part by Italian Ministry of University Research and Science and Technology, and Istituto Nazionale di Fisica Nucleare
(Preprint-883; ETN-93-92983) Avail: CASI HC A03/MF A01

Two rigorous results on the Sherrington-Kirkpatrick mean field model for spin glasses are presented. Elementary methods, based on properties of fluctuations, with respect to the external quenched noise, of the thermodynamic variables and order parameters, are applied. The first result gives the uniform convergence of the quenched average of the free energy in the thermodynamic limit to its annealed approximation, in the high temperature regime, including the assumed critical point. The second result shows that the free energy can be expressed through a functional order parameter, of the type introduced by Parisi in the frame of the replica symmetry breaking method. The functional order parameter is implicitly given in terms of fluctuations of thermodynamic variables. ESA

N93-17024# Rome Univ. (Italy). Dipt. di Fisica.
REGULARIZATION OF CHIRAL GAUGE THEORIES
Gian Carlo Rossi (Tor Vergata Univ., Rome, Italy), Renata Sarno (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and Renata Sisto (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 28 May 1992 32 p Sponsored in part by Italian Ministry of University Research and Science and Technology
(Preprint-888; ROM2-F-22; ETN-93-92988) Avail: CASI HC A03/MF A01

An explicit two loop calculation is presented. The investigation shows that, as a consequence of the breaking of chiral gauge symmetry induced by the regularization, non-gauge invariant counterterms are presented in the ghost sector of a chiral gauge theory. This occurrence prevents inversion of the Faddeev-Popov procedure and removal of the gauge fixing in numerical simulations. The theoretical framework of this investigation and the results are discussed. Calculations, conclusions, and technical details are provided. The expression of the Becchi-Rouet-Stora transformations and the Feynman rules of a chiral gauge theory are given. The formalism of dimensional regularization is reviewed. The one loop calculation of the three point gauge boson Green function is described. ESA

N93-17027# Rome Univ. (Italy). Dipt. di Fisica.
GRIBOV COPIES AND SMEARED CORRELATION FUNCTIONS IN LATTICE QCD
Maria Luigia Paciello (Istituto Nazionale di Fisica Nucleare, Rome, Italy), Claudio Parrinello (New York Univ., New York.), Silvano Petrarca (Istituto Nazionale di Fisica Nucleare, Rome, Italy), Bruno Taglienti (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and Anastassios Vladikas (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 24 Jun. 1992 13 p Sponsored by CNR, and Istituto Nazionale di Fisica Nucleare
(Preprint-892; ETN-93-92991) Avail: CASI HC A03/MF A01

The influence of Gribov copies in the Coulomb gauge in the smeared hadronic correlation functions, involved in the determination of the B meson decay constant, are studied. The current understanding of Quantum Chromodynamics (QCD) phenomenology in the lattice often proceeds through Monte Carlo simulations involving gauge dependent operators, like smeared sources for hadronic correlation functions. The residual gauge freedom associated to Gribov copies induces observable noise effects; at the level of numerical accuracy of the simulation these effects are not relevant to the final determination of f(sub B). The results indicate that such effects may become important on bigger lattices. ESA

N93-17183# Stanford Linear Accelerator Center, CA.
QCD ON THE LIGHT CONE
S. J. Brodsky Sep. 1992 18 p Presented at the QCD: 20 Years Later Workshop, Aachen, Germany, 9-13 Jun. 1992
(Contract DE-AC03-76SF-00515)
(DE93-001822; SU-SLAC-PUB-5917; CONF-9206302-1) Avail: CASI HC A03/MF A01

The quantization of gauge theory at fixed light-cone time, tau = t - z/c, provides new perspectives for solving non-perturbative problems in quantum chromodynamics. The light-cone Fock state expansion provides

both a precise definition of the relativistic wavefunctions of hadrons as bound-states of quarks and gluons and a general calculus for predicting QCD processes at the amplitude level. Applications to exclusive processes and weak decay amplitudes are discussed. The problem of computing the hadronic spectrum and the corresponding light-cone wavefunctions of QCD in one space and one time dimension has been successfully reduced to the diagonalization of a discrete representation of the light-cone Hamiltonian. The problems confronting the solution of gauge theories in 3 + 1 dimensions in the light-cone quantization formalism, including zero modes and non-perturbative renormalization, are reviewed. DOE

N93-17185# Stanford Linear Accelerator Center, CA.
DRESSED SKELETON EXPANSION AND THE COUPLING SCALE AMBIGUITY PROBLEM
Hung Jung Lu Sep. 1992 126 p
(Contract DE-AC03-76SF-00515)
(DE93-002516; SU-SLAC-406) Avail: CASI HC A07/MF A02

Perturbative expansions in quantum field theories are usually expressed in powers of a coupling constant. In principle, the infinite sum of the expansion series is independent of the renormalization scale of the coupling constant. In practice, there is a remnant dependence of the truncated series on the renormalization scale. This scale ambiguity can severely restrict the predictive power of theoretical calculations. The dressed skeleton expansion is developed as a calculational method which avoids the coupling scale ambiguity problem. In this method, physical quantities are expressed as functional expansions in terms of a coupling vertex function. The arguments of the vertex function are given by the physical momenta of each process. These physical momenta effectively replace the unspecified renormalization scale and eliminate the ambiguity problem. This method is applied to various field theoretical models and its main features and limitations are explored. For quantum chromodynamics, an expression for the running coupling constant of the three-gluon vertex is obtained. The effective coupling scale of this vertex is shown to be essentially given by mu(exp 2) approximately = Q(sub min)(exp 2)Q(sub med)(exp 2)/Q(sub max)(exp 2) where Q(sub min)(exp 2)Q(sub med)(exp 2)/Q(sub max)(exp 2) are, respectively, the smallest, the next-to-smallest, and the largest scale among the three gluon virtualities. This functional form suggests that the three-gluon vertex becomes non-perturbative at asymmetric momentum configurations. Implications for four-jet physics is discussed. DOE

N93-17215# Rome Univ. (Italy). Dipt. di Fisica.
QUANTUM CHAOS WITHOUT CLASSICAL COUNTERPART
Giovanni Jona-Lasinio, Carlo Presilla, and Federico Capasso (Bell Telephone Labs., Inc., Murray Hill, NJ.) 15 Oct. 1991 11 p
(Preprint-830; ETN-93-92933) Avail: CASI HC A03/MF A01

A quantum many body system undergoing multiple resonant tunneling which exhibits chaotic behavior in numerical simulations of a mean field approximation is described. This phenomenon has no counterpart in the classical limit and is due to effective nonlinearities in the tunneling process. The phenomena can be observed in principle within a heteorostructure. The objective of the study is to discuss whether it is possible to have quantum chaos, transient or persistent, independently of what happens in the classical limit. The system analyzed consists of a cloud of electrons moving in a three well heterostructure, and the heterostructure is shaped in such a way that the system is closed. The state of the electrons is described with a one particle wave function obeying a nonlinear Hartree equation. ESA

N93-17224# Rome Univ. (Italy). Dipt. di Fisica.
COMBINATORIAL AND TOPOLOGICAL PHASE STRUCTURE OF NON-PERTURBATIVE n-DIMENSIONAL QUANTUM GRAVITY
M. Carfora (Pavia Univ., Italy), M. Martellini (Pavia Univ., Italy), and A. Marzuoli (Pavia Univ., Italy) 28 Jan. 1992 15 p
(Preprint-861; ETN-93-92963) Avail: CASI HC A03/MF A01

A nonperturbative geometrical characterization of the partition function of n dimensional quantum gravity is provided. The characterization is based on a coarse classification of riemannian geometries. Under natural geometrical constraints, the theory admits a continuum limit with a nontrivial phase structure parameterized by the homotopy types of these class of manifolds considered. The results obtained for two dimensions are in good agreement with those of two dimensional quantum gravity models based on random triangulations of surfaces. ESA

N93-17232# Los Alamos National Lab., NM.
A NEED FOR NON-TOKAMAK APPROACHES TO MAGNETIC FUSION ENERGY
C. G. Bathke, R. A. Krakowski, and R. L. Miller 1992 7 p
(Contract W-7405-eng-36)
(DE93-000794; LA-UR-92-2904) Avail: CASI HC A02/MF A01

Focusing exclusively on conventional tokamak physics in the quest for commercial fusion power is premature, and the options for both advanced-tokamak and non-tokamak concepts need continued investigation. The basis for this claim is developed, and promising advanced-tokamak and non-tokamak options are suggested. DOE

N93-17364# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Physics.
CP VIOLATION IN THE DECAYS B(SUP 0) YIELDS (PSI)K(SUB s) AND B(SUP 0) YIELDS (PI)(+)(PI)(-): A PROBE FOR NEW PHYSICS
J. M. Soares and L. Wolfenstein 27 May 1992 15 p
(Contract DE-FG02-91ER-40682)
(DE93-002413; DOE/ER-40682/6; CMU-HEP-92-11) Avail: CASI HC A03/MF A01

We point out the strong correlation between the CP-violating asymmetries in the decays B(sup 0) yields psi(K sub s) and B(sup 0) yields pi(+)pi(-) that is predicted by the Kobayashi-Maskawa model. This results in a very restricted allowed region for the asymmetries, and so their measurement will provide a powerful test of the standard model. To show how new physics may give very different results, we look at the predictions of a simple model where both the standard model and superweak contributions to the K(sup 0) and B(sup 0) mass matrices coexist. We find that, for possible values of the parameters, practically any values are allowed for the asymmetries. DOE

N93-17589# Technische Univ., Eindhoven (Netherlands).
THE UNCERTAINTY PRINCIPLE Ph.D. Thesis
Hans Martens 1991 237 p
(ETN-92-92533) Avail: CASI HC A11/MF A03

Formal aspects and consequences of the Uncertainty Principle (UP) are presented. An historical prelude describing the advent of quantum mechanics, Hilbert space and UP is given. Formal aspects cover the scatter principle, the inaccuracy principal and independence. Consequences cover disturbance interpretations, Wigner Araki Yanase restrictions on measurement, trajectory and SQL (Standard Quantum Limit), interference versus path, and measurement process (optical Kerr effect and Stern Gerlach). An evaluation of UP is given. The results show the importance of viewing things from the most general point of view that is practicable. ESA

N93-17787# Carnegie-Mellon Univ., Pittsburgh, PA.
METASTABLE COSMIC STRINGS IN REALISTIC MODELS
R. Holman, S. Hsu (Harvard Univ., Cambridge, MA.), and T. Vachaspati (Tufts Univ., Medford, MA.) 1992 25 p
(Contract DE-FG02-91ER-40682)
(DE93-002647; DOE/ER-40682/15; FERMILAB-Pub-92/228-A; HUTP-92/A032; CMU-HEP-92-20) Avail: CASI HC A03/MF A01

The stability of the electroweak Z-string is investigated at high temperatures. The results show that, while finite temperature corrections can improve the stability of the Z-string, their effect is not strong enough to stabilize the Z-string in the standard electroweak model. Consequently, the Z-string will be unstable even under the conditions present during the electroweak phase transition. Phenomenologically viable models based on the gauge group SU(2)(sub L) x SU(2)(sub R) x U(1)(sub B-L) are then considered, and it is shown that metastable strings exist and are stable to small perturbations for a large region of the parameter space for these models. It is also shown that these strings are superconducting with bosonic charge carriers. The string superconductivity may be able to stabilize segments and loops against dynamical contraction. Possible implications of these strings for cosmology are discussed. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N93-16521# City Coll. of Chicago-Truman Coll., IL.
VENTURES IN SCIENCE Status Report, 1992

1992 49 p
(Contract DE-FG02-91ER-75650)
(DE93-003044; DOE/ER-75650/1) Avail: CASI HC A03/MF A01

The Ventures in Science Summer Program is directed towards students who are from underrepresented minority groups in mathematics and science professions. The target group of 40 was drawn from eligible students who will be entering high school freshman in the fall of 1992. Four hundred and fifty students applied. The theme for the summer is Chicago as an Ecosystem. The students are instructed in integrated math and science (2 hours), English/ESL (1 1/2 hrs.), counseling (1 hr.) and, physical education (1 hr.) each day, four days a week. Integrated math and science are team taught. Parents are invited to participate in two workshops that will be presented based on their input. Parents may also visit the program at any time and participate in any field trip. DOE

N93-16624*# Huntsville Rehabilitation Foundation, Inc., AL.
FUTURE ASSETS, STUDENT TALENT (FAST) Research Report, Jul. 1992 - Jul. 1993
1992 28 p
(Grant NAGw-3142)
(NASA-CR-191632; NAS 1.26:191632) Avail: CASI HC A03/MF A01

Future Assets, Student Talent (FAST) motivates and prepares talented students with disabilities to further their education and achieve High Tech and professional employment. The FAST program is managed by local professionals, business, and industry leaders; it is modeled after High School High Tech project TAKE CHARGE started in Los Angeles in 1983. Through cooperative efforts of Alabama Department of Education, Vocational Rehabilitation, Adult and Children Services, and the President's Committee on Employment of People with Disabilities, north central Alabama was chosen as the second site for a High School High Tech project. In 1986 local business, industry, education, government agencies, and rehabilitation representatives started FAST. The program objectives and goals, results and accomplishments, and survey results are included. L.R.R.

N93-16735# TVOntario, Toronto.
IMPLEMENTATION OF EDUCATIONAL BROADCASTING IN SPACE, PHASE 1 Final Report
14 Nov. 1988 23 p
(Contract DSS-31098-7-6027/SW)
(CTN-93-60623) Avail: CASI HC A03/MF A01

TVOntario has initiated a space education project whose objectives include the development of expertise in microgravity or space broadcasting and to produce quality educational programs on space science. As part of this project, TVOntario is working with industry and university scientists to develop flight qualified experiments that would illustrate certain characteristics of the microgravity environment and that would be videotaped for broadcast. The University of Toronto Institute for Aerospace Studies was asked to design and build a generic test bed and a series of microgravity experimental cells for use on the June 1988 KC-135 aircraft flight. Experiments were selected to demonstrate the influence of microgravity on a range of liquid properties, and the effects in the cells were intended to represent various stages of manufacturing processes which could be improved by transfer to a microgravity environment. The test bed incorporates a broadcast quality video package. The technical design requirements and hardware description of this microgravity experiment and broadcast apparatus are presented. On the KC-135 flight, the experimental package performed extremely well, capturing the desired phenomena with excellent resolution. From a mechanical viewpoint, the package performed at perhaps an 80 percent level. CISTI

N93-16760*# Hampton Univ., VA.
NASA/AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE) SUMMER FACULTY FELLOWSHIP PROGRAM 1992 Report, 1 Jun. - 7 Aug. 1992
John H. Spencer, comp. Sep. 1992 223 p
(Grant NGT-47-020-800)
(NASA-CR-189691; NAS 1.26:189691) Avail: CASI HC A10/MF A03

Since 1964, the National Aeronautics and Space Administration (NASA) has supported a program of summer faculty fellowships for engineering and science educators. In a series of collaborations between NASA research and development centers and nearby universities, engineering faculty members spend 10 weeks working with professional peers on research. The Summer Faculty Program Committee of the American Society for Engineering Education supervises the programs. Objectives of the program are (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate and exchange ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of participants' institutions; and (4) to contribute to the research objectives of the NASA center. For individual titles, see N93-16761 through N93-16798.

N93-16761*# Hampton Univ., VA. Dept. of Mass Media Arts.
THE NASA HIGH-SPEED RESEARCH PROGRAM **c05**
Sherilee F. Beam *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 71-74 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Since its inception, one of NASA's commitments has been to develop the technology to advance aeronautics. As such, a new High-Speed Research Program was activated to develop the technology for industry to build a High-Speed Civil Transport - a second generation Supersonic Transport (SST). The baseline for this program is the British Concorde, a major technological achievement for its time, but an aircraft which is now both technologically and economically outdated. Therefore, a second generation SST must satisfy environmental concerns and still be economically viable. In order to do this, it must have no significant effect on the ozone layer, meet Federal Air Regulation 36, Stage 3 for community noise, and have no perceptible sonic boom over populated areas. These three concerns are the focus of the research efforts in Phase 1 of the program and are the specific areas covered in the technical video report. L.R.R.

N93-16762*# State Univ. of New York, Buffalo. Dept. of Mechanical and Aerospace Engineering.
AN INTELLIGENT DECOMPOSITION APPROACH FOR EFFICIENT DESIGN OF NON-HIERARCHIC SYSTEMS **c61**
Christina L. Bloebaum *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 75-78 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

The design process associated with large engineering systems requires an initial decomposition of the complex systems into subsystem modules which are coupled through transference of output data. The implementation of such a decomposition approach assumes the ability exists to determine what subsystems and interactions exist and what order of execution will be imposed during the analysis process. Unfortunately, this is quite often an extremely complex task which may be beyond human ability to efficiently achieve. Further, in optimizing such a coupled system, it is essential to be able to determine which interactions figure prominently enough to significantly affect the accuracy of the optimal solution. The ability to determine 'weak' versus 'strong' coupling strengths would aid the designer in deciding which couplings could be permanently removed from consideration or which could be temporarily suspended so as to achieve computational savings with minimal loss in solution accuracy. An approach that uses normalized sensitivities to quantify coupling strengths is presented. The approach is applied to a coupled system composed of analysis equations for verification purposes. Author

N93-16763*# University of South Florida, Tampa. Dept. of Civil Engineering and Mechanics.
THE ROLE OF UNDER-DETERMINED APPROXIMATIONS IN ENGINEERING AND SCIENCE APPLICATION **c64**
William C. Carpenter *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 79-86 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

There is currently a great deal of interest in using response surfaces in the optimization of aircraft performance. The objective function and/or constraint equations involved in these optimization problems may come from numerous disciplines such as structures, aerodynamics, environmental engineering, etc. In each of these disciplines, the mathematical complexity of the governing equations usually dictates that numerical results be obtained from large computer programs such as a finite element method program. Thus, when performing optimization studies, response surfaces are a

convenient way of transferring information from the various disciplines to the optimization algorithm as opposed to bringing all the sundry computer programs together in a massive computer code. Response surfaces offer another advantage in the optimization of aircraft structures. A characteristic of these types of optimization problems is that evaluation of the objective function and response equations (referred to as a functional evaluation) can be very expensive in a computational sense. Because of the computational expense in obtaining functional evaluations, the present study was undertaken to investigate under-determinined approximations. An under-determined approximation is one in which there are fewer training pairs (pieces of information about a function) than there are undetermined parameters (coefficients or weights) associated with the approximation. Both polynomial approximations and neural net approximations were examined. Three main example problems were investigated: (1) a function of one design variable was considered; (2) a function of two design variables was considered; and (3) a 35 bar truss with 4 design variables was considered. Author

N93-16764*# Hampton Univ., VA. Dept. of Chemistry.
UNDERSTANDING CRYSTALLINITY IN AROMATIC POLYIMIDES c27
Edward A. Celarier *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 87-90 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Aromatic polyimides are a class of polymers that show remarkable thermal stability, strength, and toughness. These properties make them attractive candidates for use in high-performance carbon fiber composites for airborne and spaceborne structural components. Our research centered on the development of an understanding of the underlying process of crystallite formation in a particular class of aryl polyimides for which there are some x-ray crystallographic data available. The ultimate aim of the project is to be able to develop a model sufficiently flexible to be able, on the basis of the chemical structure of a polymer in this class, to predict: (1) whether it will be prone to form crystallites; (2) crystallographic features of the crystallites; and (3) synthesis and/or processing conditions that will be favorable or unfavorable to crystallite formation. This will provide guidance to the laboratory chemists in their choice of candidate polymers and processing methods. Author

N93-16765*# Illinois Univ., Chicago. Dept. of Mechanical Engineering.
INTERFEROMETRIC RECONSTRUCTION OF THREE-DIMENSIONAL HIGH-SPEED AERODYNAMIC FLOWS c02
Soyoung Stephen Cha *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 91-92 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Holographic interferometry can be a very useful diagnostic tool in high-speed aerodynamic testing. During this summer research period, various possible approaches for accurately reconstructing three-dimensional flows from limited data were examined. The approach based on the combination of the following three techniques appears to be promising: (1) Continuous Local Basis Function Method - this computational tomographic method has a power to accurately reconstruct continuous regions and is appropriate from well-conditioned to moderately limited data; (2) Variable Basis Method - this computational tomographic method provides accuracy near discontinuities, i.e., shock regions, and is appropriate from moderately-limited to severely-limited data; and (3) Complementary Field Method - this is a general iterative reconstructor that can be coupled with any computational tomographic techniques. Mathematically, it can be shown that this method can provide better accuracy than the direct reconstruction as in a conventional approach. Our numerical simulation of experiments demonstrated improved reconstruction results even when these techniques were individually tested. Author

N93-16766*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PHYSICAL AGING AND SOLVENT EFFECTS ON THE FRACTURE OF LARC-TPI ADHESIVES c27
David A. Dillard (Virginia Polytechnic Inst. and State Univ., Blacksburg.), Terry L. St.Clair, and W. Steven Johnson *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 93-96 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

When amorphous materials are quenched below their glass transition temperature, excess enthalpy is trapped in the glassy material because the viscosity is too great to allow the material to remain in volumetric equilibrium. Over time, this excess free volume is reduced as the material slowly approaches its equilibrium configuration. This process, known as physical aging, leads to substantial changes in the constitutive behavior of polymers, as has been widely discussed in the literature. Less is known about the effects of this physical aging process on fracture and fatigue properties of aged materials. The original goal of the summer was to investigate the effects of physical aging on the fracture and fatigue behavior of LaRC-TPI, a thermoplastic polyimide developed at NASA-Langley. Preliminary results are reported, although a lack of equipment availability prevented completion of this task. In the process of making specimens, the current LaRC-TPI was observed to be extremely susceptible to environmental stress cracking. A study of the unique failure patterns resulting from this degradation process in bonded joints was conducted and is also reported herein. Author

N93-16767*# Norfolk State Univ., VA. Dept. of Chemistry and Physics.
FATIGUE DAMAGE STUDY IN ALUMINUM-2024 T3 ALLOYS c26
Milton W. Ferguson *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 97-98 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

The grain structure of aluminum 2024, a commonly used commercial alloy is investigated, and these findings are correlated with the fatigue property of the material. Samples of aluminum 2024 were polished and etched in different reagents. Optical micrographs (at 500X) of samples etched in Keller's reagent revealed grain boundaries as well as some particles present in the microstructure. Normal x-ray scans of samples etched for different intervals of time in Keller's reagent indicate no significant variations in diffraction peak positions; however, the width of the rocking curve increased with the time of etching. These results are consistent with the direct dependence of the width of the rocking curve on the range of grain orientation. Etching removes the preferred orientation layer of the sample produced by polishing; thereby, causing the width to increase. Author

N93-16768*# Missouri Univ., Rolla. Dept. of Mechanical and Aerospace Engineering.
PRELIMINARY EFFORTS TOWARD DEVELOPMENT OF DATA HANDLING AND ANALYSIS SOFTWARE FOR UNSTEADY FLOW MEASUREMENTS: AN APPLICATION FOR AEROELASTIC TRANSONIC FLOW CONFIGURATIONS c02
Fathi Finaish *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 99-105 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

A few years ago the Structural Dynamics Division at LaRC started ambitious experimental research efforts known as the Benchmark Models Program. The primary objective of this program was to provide experimental data that may serve as a calibration source for computational fluid dynamics (CFD) efforts that deal with aeroelastic unsteady flow configurations. It also focuses on the understanding of complex flow phenomenon associated with unsteady flow developments. The overall plan for the program has been described by Bennett, including a presentation of initial test results of flutter of a rigid wing mounted on flexible supports. An example of a test model employed to measure the dynamic response along with corresponding pressure distributions is shown. This model incorporates eighty pressure transducers distributed along two spanwise stations. In addition, the models are equipped with four accelerometers and two strain gages. The data handling system for the Benchmark Model Program is under development. Several interactive computer routines designed for the user interface, dynamic memory allocation, unsteady flow measurements data extraction, and further data processing were developed. To present a few examples of measured data, the unsteady pressure distributions and the wing model dynamic response were plotted. Author

N93-16769*# Michigan State Univ., East Lansing. Dept. of Mechanical Engineering.
DEVELOPING A CONTROL SYSTEM FOR ARES 2 **c08**
Philip M. FitzSimons *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 106-109 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

A great deal of analysis and testing is conducted at the NASA Langley Research Center to support the development of safe and reliable helicopter rotor systems. This work is performed by the Rotorcraft Aeroelasticity Group located in the Transonic Dynamics Tunnel (TDT) facility. Over the past two decades a wide variety of tests have been successfully conducted in the TDT and their results have contributed significantly to the understanding of aeromechanical phenomena in rotor systems. This has led to improved tools for analysis and design, and ultimately to the development, of improved rotor systems. The TDT facility is ideally suited for these tests due to its unique ability to use a heavy gas as a working medium. This allows the model to be scaled such that the results obtained may be readily extrapolated to full scale. Until recently, the rotor system to be tested has been mounted on a fixed balance which is attached to the longeron which is attached to the stand through a single pitching degree of freedom. The testbed used is known as the Aeroelastic Rotor Experimental System (ARES 1). In order to extend the experimental capabilities to investigate the full rotor/body dynamic coupling present in a rotorcraft, a very ambitious project has been undertaken to design and construct a six degree of freedom system that can be controlled so as to emulate the inertial characteristics of a prescribed model fuselage. The electronic and mechanical hardware for this system has already been designed and constructed. This system is known ar ARES II. The rotor and its drive system are mounted on the balance which is attached to the longeron via six hydraulic actuators. This six degree of freedom parallel linkage is referred to in the literature as a Stuart Platform. By properly adjusting the length of the hydraulic actuators it is possible to position and orient the balance relative to the longeron. The longeron is attached to the stand via a pitch degree of freedom to allow testing over various forward flight regimes. One major task remaining to complete this testbed is the design and synthesis of a control system. To do this properly requires an understanding of the kinematics and dynamics of the system and robust control design. A brief description of the development of a control design is given. Author

N93-16770*# Wilkes Coll., Wilkes-Barre, PA. Dept. of Mechanical Engineering.
WIND TUNNEL SEEDING PARTICLES FOR LASER VELOCIMETER **c02**
Anthony Ghorieshi *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 110-115 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

The design of an optimal air foil has been a major challenge for aerospace industries. The main objective is to reduce the drag force while increasing the lift force in various environmental air conditions. Experimental verification of theoretical and computational results is a crucial part of the analysis because of errors buried in the solutions, due to the assumptions made in theoretical work. Experimental studies are an integral part of a good design procedure; however, empirical data are not always error free due to environmental obstacles or poor execution, etc. The reduction of errors in empirical data is a major challenge in wind tunnel testing. One of the recent advances of particular interest is the use of a non-intrusive measurement technique known as laser velocimetry (LV) which allows for obtaining quantitative flow data without introducing flow disturbing probes. The laser velocimeter technique is based on measurement of scattered light by the particles present in the flow but not the velocity of the flow. Therefore, for an accurate flow velocity measurement with laser velocimeters, two criterion are investigated: (1) how well the particles track the local flow field, and (2) the requirement of light scattering efficiency to obtain signals with the LV. In order to demonstrate the concept of predicting the flow velocity by velocity measurement of particle seeding, the theoretical velocity of the gas flow is computed and compared with experimentally obtained velocity of particle seeding. L.R.R.

N93-16771*# Clarkson Univ., Potsdam, NY. Dept. of Mechanical and Aeronautical Engineering.
NEAR-WALL RECONSTRUCTION OF HIGHER ORDER MOMENTS AND LENGTH SCALES USING THE POD **c34**
Mark N. Glauser *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 116-120 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

An analysis of the near-wall behavior of the proper orthogonal decomposition (POD) eigenfunctions derived from direct numerical simulation (DNS) of channel flow is performed. Consistent with previous studies, a low order multi-mode reconstruction of the kinetic energy and Reynolds shear stress suffices. A similar reconstruction of the isotropic dissipation rate is shown to be insufficient, however. An analysis is performed of the multi-mode composition of the dissipation rate in the near-wall region, and it is shown that a significant number of higher-order modes are required to achieve the correct asymptotic consistency in the near-wall region. In an attempt to avoid this problem, a length scale definition is proposed in terms of an integration of the correlation tensor which factors in the presence of the wall. The wall is accounted for by only integrating out to $2y(+)$ and not over the entire domain. Viscous and inviscid estimates for the dissipation were used in the near-wall and core regions respectively, in conjunction with this length scale representation to obtain an estimate of the dissipation throughout the domain. The resulting dissipation exhibits the proper behavior near the wall and in the inertial layer. A 1 POD mode estimate of the length scale is computed and found to agree quite well with the length scale obtained when the entire correlation tensor is used. Author

N93-16772*# Drexel Univ., Philadelphia, PA. Dept. of Electrical and Computer Engineering.
FUNCTIONAL EXPANSION REPRESENTATIONS OF ARTIFICIAL NEURAL NETWORKS **c63**
W. Steven Gray *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 121-123 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

In the past few years, significant interest has developed in using artificial neural networks to model and control nonlinear dynamical systems. While there exists many proposed schemes for accomplishing this and a wealth of supporting empirical results, most approaches to date tend to be ad hoc in nature and rely mainly on heuristic justifications. The purpose of this project was to further develop some analytical tools for representing nonlinear discrete-time input-output systems, which when applied to neural networks would give insight on architecture selection, pruning strategies, and learning algorithms. A long term goal is to determine in what sense, if any, a neural network can be used as a universal approximator for nonliner input-output maps with memory (i.e., realized by a dynamical system). This property is well known for the case of static or memoryless input-output maps. The general architecture under consideration in this project was a single-input, single-output recurrent feedforward network. Author

N93-16773*# Christopher Newport Coll., Newport News, VA.
SPACECRAFT OPTICAL DISK RECORDER MEMORY BUFFER CONTROL **c35**
Robert F. Hodson *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 124-127 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

The goal of this project is to develop an Application Specific Integrated Circuit (ASIC) for use in the control electronics of the Spacecraft Optical Disk Recorder (SODR). Specifically, this project is to design an extendable memory buffer controller ASIC for rate matching between a system Input/Output port and the SODR's device interface. The aforementioned goal can be partitioned into the following sub-goals: (1) completion of ASIC design and simulation (on-going via ASEE fellowship); (2) ASIC Fabrication (at ASIC manufacturer); and (3) ASIC Testing (NASA/LaRC, Christopher Newport University). Author

N93-16774*# Hope College, Holland, MI. Dept. of Computer Science.
CREATING AN OPEN ENVIRONMENT SOFTWARE INFRASTRUCTURE **c61**

Michael J. Jipping *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 128-129 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

As the development of complex computer hardware accelerates at increasing rates, the ability of software to keep pace is essential. The development of software design tools, however, is falling behind the development of hardware for several reasons, the most prominent of which is the lack of a software infrastructure to provide an integrated environment for all parts of a software system. The research was undertaken to provide a basis for answering this problem by investigating the requirements of open environments. Author

N93-16775*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
VIRTUAL REALITY SYSTEMS c60
David W. Johnson *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 130-132 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Virtual realities are a type of human-computer interface (HCI) and as such may be understood from a historical perspective. In the earliest era, the computer was a very simple, straightforward machine. Interaction was human manipulation of an inanimate object, little more than the provision of an explicit instruction set to be carried out without deviation. In short, control resided with the user. In the second era of HCI, some level of intelligence and control was imparted to the system to enable a dialogue with the user. Simple context sensitive help systems are early examples, while more sophisticated expert system designs typify this era. Control was shared more equally. In this, the third era of the HCI, the constructed system emulates a particular environment, constructed with rules and knowledge about 'reality'. Control is, in part, outside the realm of the human-computer dialogue. Virtual reality systems are discussed. L.R.R.

N93-16776*# College of William and Mary, Williamsburg, VA. Dept. of Mathematics.
THE DAMPER PLACEMENT PROBLEM FOR LARGE FLEXIBLE SPACE STRUCTURES c18
Rex K. Kincaid *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 133-135 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

The damper placement problem for large flexible space truss structures is formulated as a combinatorial optimization problem. The objective is to determine the p truss members of the structure to replace with active (or passive) dampers so that the modal damping ratio is as large as possible for all significant modes of vibration. Equivalently, given a strain energy matrix with rows indexed on the modes and the columns indexed on the truss members, we seek to find the set of p columns such that the smallest row sum, over the p columns, is maximized. We develop a tabu search heuristic for the damper placement problems on the Controls Structures Interaction (CSI) Phase 1 Evolutionary Model (10 modes and 1507 truss members). The resulting solutions are shown to be of high quality. Author

N93-16777*# Norfolk State Univ., VA. Dept. of Computer Science.
QUANTIFYING PARAMETERS FOR BAYESIAN PRIOR ASSUMPTIONS WHEN ESTIMATING THE PROBABILITY OF FAILURE OF SOFTWARE c61
Jacquelyn E. Long *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 136-138 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Software reliability has become increasingly important, especially in life-critical situations. The ability to measure the results of testing and to quantify software reliability is needed. If this is accomplished, a certain minimum amount of reliability for a piece of software can be specified, and testing and/or other analysis may be done until that minimum number has been attained. There are many models for estimating software reliability. The accuracy of these models has been challenged and many revisions for the models and recalibration techniques have been devised. Of particular interest is the method of estimating the probability of failure of software when no failures have yet occurred in its current version as described by Miller. This model uses black box testing with formulae based on Bayesian estimation. The focus is on three interrelated issues: estimating the probability of failure when testing has revealed no errors; modifying this estimation when the input use distribution does not match the test distribution; and combining the results from random testing with other relevant information to obtain a possibly more accurate estimate of the probability of failure. Obtaining relevant information about the software and combining the results for a better estimate for the Miller model are discussed. Author

N93-16778*# University of Southern Illinois, Carbondale. Dept. of Physics.
VARIATIONAL DERIVATION OF EQUATION FOR GENERALIZED PAIR CORRELATION FUNCTION c61
F. Bary Malik *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 139-141 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

The wavefunction of a system is explicitly written down in a fully anti-symmetric way between a fermion pair and a medium, and the equations for each one of them are derived from the variation of total energy for bound systems and by forming appropriate scalar products for continuum states. High-energy particles, such as protons, electrons, and nuclei impinging upon spacecraft, produce secondary radiations. In order to protect the internal environment of spacecraft from these radiations, their intensities are determined in many instances theoretically, and an appropriate program has been developed in the High Energy Science Branch. The purpose of this research is to investigate the problem of indistinguishability of an incident projectile with one of the same in a target. Author

N93-16779*# Wichita State Univ., KS. Dept. of Industrial Engineering.
FUZZY SET APPROACH TO QUALITY FUNCTION DEPLOYMENT: AN INVESTIGATION Abstract Only Final Report c64
Abu S. M. Masud *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 142 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

The final report of the 1992 NASA/ASEE Summer Faculty Fellowship at the Space Exploration Initiative Office (SEIO) in Langley Research Center is presented. Quality Function Deployment (QFD) is a process, focused on facilitating the integration of the customer's voice in the design and development of a product or service. Various input, in the form of judgements and evaluations, are required during the QFD analyses. All the input variables in these analyses are treated as numeric variables. The purpose of the research was to investigate how QFD analyses can be performed when some or all of the input variables are treated as linguistic variables with values expressed as fuzzy numbers. The reason for this consideration is that human judgement, perception, and cognition are often ambiguous and are better represented as fuzzy numbers. Two approaches for using fuzzy sets in QFD have been proposed. In both cases, all the input variables are considered as linguistic variables with values indicated as linguistic expressions. These expressions are then converted to fuzzy numbers. The difference between the two approaches is due to how the QFD computations are performed with these fuzzy numbers. In Approach 1, the fuzzy numbers are first converted to their equivalent crisp scores and then the QFD computations are performed using these crisp scores. As a result, the output of this approach are crisp numbers, similar to those in traditional QFD. In Approach 2, all the QFD computations are performed with the fuzzy numbers and the output are fuzzy numbers also. Both the approaches have been explained with the help of illustrative examples of QFD application. Approach 2 has also been applied in a QFD application exercise in SEIO, involving a 'mini moon rover' design. The mini moon rover is a proposed tele-operated vehicle that will traverse and perform various tasks, including autonomous operations, on the moon surface. The output of the moon rover application exercise is a ranking of the rover functions so that a subset of these functions can be targeted for design improvement. The illustrative examples and the mini rover application exercise confirm that the proposed approaches for using fuzzy sets in QFD are viable. However, further research is needed to study the various issues involved and to verify/validate the methods proposed. Author

N93-16780*# Massachusetts Inst. of Tech., Cambridge.
PREDICTION OF THERMAL CYCLING INDUCED MATRIX CRACKING **c24**

Hugh L. McManus *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 143-146 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Thermal fatigue has been observed to cause matrix cracking in laminated composite materials. A method is presented to predict transverse matrix cracks in composite laminates subjected to cyclic thermal load. Shear lag stress approximations and a simple energy-based fracture criteria are used to predict crack densities as a function of temperature. Prediction of crack densities as a function of thermal cycling is accomplished by assuming that fatigue degrades the material's inherent resistance to cracking. The method is implemented as a computer program. A simple experiment provides data on progressive cracking of a laminate with decreasing temperature. Existing data on thermal fatigue is also used. Correlations of the analytical predictions to the data are very good. A parametric study using the analytical method is presented which provides insight into material behavior under cyclical thermal loads. Author

N93-16781*# Norfolk State Univ., VA. Dept. of Chemistry.
DIODE INJECTION - SEEDED, 940 NANOMETER (nm), TITANIUM - SAPPHIRE LASER FOR H2O DIAL (DIFFERENTIAL ABSORPTION LIDAR), MEASUREMENTS **c36**

George E. Miller *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 147-152 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

Differential absorption of laser radiation by various molecular species represents both a selective and a sensitive method of measuring specific atmospheric constituents. DIAL measurements can be carried out via two different means. Both involve using two laser pulses with slightly different wavelengths (lambda), (one lambda at a strong absorption line of the molecule of interest, the other detuned into the wing of the line), and comparing the attenuation of the pulses. One approach relies on scattering of the radiation from some conveniently located topographical target. In the other technique elastic scattering from atmospheric aerosols and particulates is used to return the radiation to the lidar receiver system. This case is referred to as the differential absorption and scattering technique, and is the technique we are interested in to measure water vapor at 940 nm. The 940 nm wavelength is extremely desirable to atmospheric scientist interested in accurate DIAL measurements of H2O in the upper and lower troposphere. Simulated measurements using approximately 940 nm and 815 nm lasers at a range of altitudes and experimental conditions are shown. By offering access to larger absorption cross-sections, injected seeded, 940 nm DIAL laser transmitters would allow for more accurate water profile measurements at altitudes from 6 to 16 km than is currently possible with 730 nm and 815 nm DIAL laser transmitters. We have demonstrated the operation of an injected seeded titanium-sapphire (TS) laser operating at approximately 940 nm with an energy of more than 90 mJ per pulse. The TS laser is pumped by a commercial, 600 mJ, 532 nm, 10 Hz Nd:YAG laser. The slope efficiency of the laser using a flat 50 percent R output coupler and a 10 m end-mirror is shown. The laser was injected seeded with a CW, AlGaAs, semiconductor diode laser which had an output of 83 mW. The CW diode seed beam was introduced into the TS laser cavity through a HR end-mirror. When the diode beam is aligned to the TS resonator, it controls the TS laser output wavelength and its spectral line width with the required resolution for DIAL applications. This work supports the need for the development of 940 nm, titanium-sapphire DIAL transmitters. Author

N93-16782*# Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
BEAM, PLATE, AND SHELL FINITE ELEMENTS FOR CSI DESIGN CODE Abstract Only **c39**

Duc T. Nguyen *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 153 (For primary document see N93-16760 05-80)
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Efficient triangular plate bending finite elements (with 6 degree-of-freedom per node) are surveyed. The most promising element will be selected, coded, and implemented into the current Control Structures Interactions (CSI) Design Code. Numerical example, v.i.a. CSI Design Code will be conducted to confirm the efficiency and accuracy of the selected plate bending element. Procedures to further enhance the computations of the CSI design code will be recommended. Author

N93-16783*# Ohio State Univ., Columbus. Dept. of Psychology.
COGNITIVE AND AFFECTIVE COMPONENTS OF MENTAL WORKLOAD: UNDERSTANDING THE EFFECTS OF EACH ON HUMAN DECISION MAKING BEHAVIOR **c53**

Thomas E. Nygren *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 154-156 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Human factors and ergonomics researchers have recognized for some time the increasing importance of understanding the role of the construct of mental workload in flight research. Current models of mental workload suggest that it is a multidimensional and complex construct, but one that has proved difficult to measure. Because of this difficulty, emphasis has usually been placed on using direct reports through subjective measures such as rating scales to assess levels of mental workload. The NASA Task Load Index (NASA/TLX, Hart and Staveland) has been shown to be a highly reliable and sensitive measure of perceived mental workload. But a problem with measures like TLX is that there is still considerable disagreement as to what it is about mental workload that these subjective measures are actually measuring. The empirical use of subjective workload measures has largely been to provide estimates of the cognitive components of the actual mental workload required for a task. However, my research suggests that these measures may, in fact have greater potential in accurately assessing the affective components of workload. That is, for example, TLX may be more likely to assess the positive and negative feelings associated with varying workload levels, which in turn may potentially influence the decision making behavior that directly bears on performance and safety issues. Pilots, for example, are often called upon to complete many complex tasks that are high in mental workload, stress, and frustration, and that have significant dynamic decision making components -- often ones that involve risk as well. Author

N93-16784*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
DIGITAL DATA ACQUISITION AND PRELIMINARY INSTRUMENTATION STUDY FOR THE F-16 LAMINAR FLOW CONTROL VEHICLE **c02**

Cyrus Ostowari *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 157-163 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

Preliminary studies have shown that maintenance of laminar flow through active boundary-layer control is viable. Current research activity at NASA Langley and NASA Dryden is utilizing the F-16XL-1 research vehicle fitted with a laminar-flow suction glove that is connected to a vacuum manifold in order to create and control laminar flow at supersonic flight speeds. This experimental program has been designed to establish the feasibility of obtaining laminar flow at supersonic speeds with highly swept wing and to provide data for computational fluid dynamics (CFD) code calibration. Flight experiments conducted as supersonic speeds have indicated that it is possible to achieve laminar flow under controlled suction at flight Mach numbers greater than 1. Currently this glove is fitted with a series of pressure belts and flush mounted hot film sensors for the purpose of determining the pressure distributions and the extent of laminar flow region past the stagnation point. The present mode of data acquisition relies on out-dated on board multi-channel FM analogue tape recorder system. At the end of each flight, the analogue data is digitized through a long laborious process and then analyzed. It is proposed to replace this outdated system with an on board state-of-the-art digital data acquisition system capable of a through put rate of up to 1 MegaHertz. The purpose of this study was three-fold: (1) to develop a simple algorithm for acquiring data via 2 analogue-to-digital convertor boards simultaneously (total of 32 channels); (2) to interface hot-film/wire anemometry instrumentation with a PCAT type computer; and (3) to characterize the frequency response of a flush mounted film sensor. A brief description of each of the above tasks along with recommendations are given. Author

N93-16785*# Hawaii Univ., Manoa. Dept. of Civil Engineering.
A VARIATIONAL METHOD FOR FINITE ELEMENT STRESS RECOVERY: APPLICATIONS IN ONE-DIMENSION **c39**
H. Ronald Riggs *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 164-168 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

It is well-known that stresses (and strains) calculated by a displacement-based finite element analysis are generally not as accurate as the displacements. In addition, the calculated stress field is typically discontinuous at element interfaces. Because the stresses are typically of more interest than the displacements, several procedures have been proposed to obtain a smooth stress field, given the finite element stresses, and to improve the accuracy. Hinton and Irons introduced global least squares smoothing of discrete data defined on a plane using a finite element formulation. Tessler and co-workers recently developed a conceptually similar formulation for smoothing of two-dimensional data based on a discrete least square approximation with a penalty constraint. The penalty constraint results in a stress field which is C(exp 1)-continuous, a result not previously obtained. The approach requires additional, 'smoothing' finite element analysis and for their two-dimensional application, they used a conforming C(exp 0)-continuous triangular finite element based on a conforming plate element. This paper presents the results of a detailed investigation into the application of Tessler's smoothing procedure to the smoothing of finite element stresses from one-dimensional problems. Although the one-dimensional formulation has some practical applicability, such as in truss, beam, axisymmetric mechanics, and one-dimensional heat conduction, the primary motivation for developing the one-dimensional smoothing case is to explore the characteristics of the general smoothing strategy. In particular, it is used to describe the behavior of the method and to explore the suitability of criteria proposed for the smoothing analysis. Prior to presenting numerical results, the variational formulation of the smoothing strategy is presented and a criterion for the smoothing analysis is described. Author

N93-16786*# Alabama Univ., Tuscaloosa. Dept. of Mechanical Engineering.
COMPARISON OF METHODOLOGIES FOR DESCRIBING RELAXATION IN NONEQUILIBRIUM GASEOUS SYSTEMS **c34**
Willard C. Schreiber *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 169-170 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

The heat transfer process in hypervelocity vehicles is dominated by nonequilibrium gas dynamics. One model used in computational fluid dynamics (CFD) codes to predict hypervelocity heat transfer is the 'two-temperature' model. An analysis has been made to test the validity of the two-temperature model for predicting another nonequilibrium phenomenon, sound absorption and deviation of signal speed in a high temperature gas. It is found that the two temperature model's prediction capabilities degenerate with increasing temperature. These results are felt to have significance concerning the two-temperature's ability to predict heat transfer in hypervelocity flows. Author

N93-16787*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
BOUNDARY-LAYER MEASUREMENTS ON A HIGH REYNOLDS NUMBER THREE-ELEMENT AIRFOIL **c02**
Gregory V. Selby *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 171-172 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

An experimental investigation is being conducted to evaluate the boundary layer associated with a two-dimensional three-element single-flap airfoil at high Reynolds numbers. The present measurements are being made in the Langley Low-Turbulence (centerline turbulence intensity level is 0.034 percent at a Mach number of 0.2 and a total pressure of 60 psia) Pressure Tunnel (LTPT). The LTPT is a closed-circuit wind tunnel with a test section which is 3 ft wide, 7.5 ft high, and 7.5 ft long. Operating total pressure for the LTPT varies from 10 atmospheres to near-vacuum conditions. Tests are being conducted at a Mach number of 0.2 and Reynolds numbers (based on chord length) of 5, 9, and 16 million. Measurements include boundary-layer velocity surveys at several chordwise locations and surface skin-friction measurements using Preston tubes. Author

N93-16788*# Troy State Univ., Norfolk Naval Base, VA. Dept. of Public Administration and Human Resources Management.
TOTAL QUALITY MANAGEMENT: STRENGTHS AND BARRIERS TO IMPLEMENTATION AND CULTURAL ADAPTATION **c38**
Denise V. Siegfeldt, Michael Glenn, and Louise Hamilton *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 173-174 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

NASA/Langley Research Center (LaRC) is in the process of implementing Total Quality Management (TQM) throughout the organization in order to improve productivity and make the Center an even better place to work. The purpose of this project was to determine strengths and barriers to TQM being implemented and becoming a part of the organizational culture of the Human Resources Management Division (HRMD) at Langley. The target population for this project was both supervisory and nonsupervisory staff of the HMRD. In order to generate data on strengths and barriers to TQM implementation and cultural adaptation, a modified nominal group technique was used. L.R.R.

N93-16789*# South Carolina Univ., Columbia. Dept. of Physics.
ADVANCED NDE RESEARCH IN ELECTROMAGNETIC, THERMAL, AND COHERENT OPTICS **c38**
S. Ballou Skinner *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 175 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

A new inspection technology called magneto-optic/eddy current imaging was investigated. The magneto-optic imager makes readily visible irregularities and inconsistencies in airframe components. Other research observed in electromagnetics included (1) disbond detection via resonant modal analysis; (2) AC magnetic field frequency dependence of magnetoacoustic emission; and (3) multi-view magneto-optic imaging. Research observed in the thermal group included (1) thermographic detection and characterization of corrosion in aircraft aluminum; (2) a multipurpose infrared imaging system for thermoelastic stress detection; (3) thermal diffusivity imaging of stress induced damage in composites; and (4) detection and measurement of ice formation on the space shuttle main fuel tank. Research observed in the optics group included advancements in optical nondestructive evaluation (NDE). L.R.R.

N93-16790*# Kentucky Univ., Lexington. Dept. of Electrical Engineering.
ANTENNA ANALYSIS USING NEURAL NETWORKS **c32**
William T. Smith *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 176-177 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Conventional computing schemes have long been used to analyze problems in electromagnetics (EM). The vast majority of EM applications require computationally intensive algorithms involving numerical integration and solutions to large systems of equations. The feasibility of using neural network computing algorithms for antenna analysis is investigated. The ultimate goal is to use a trained neural network algorithm to reduce the computational demands of existing reflector surface error compensation techniques. Neural networks are computational algorithms based on neurobiological systems. Neural nets consist of massively parallel interconnected nonlinear computational elements. They are often employed in pattern recognition and image processing problems. Recently, neural network analysis has been applied in the electromagnetics area for the design of frequency selective surfaces and beam forming networks. The backpropagation training algorithm was employed to simulate classical antenna array synthesis techniques. The Woodward-Lawson (W-L) and Dolph-Chebyshev (D-C) array pattern synthesis techniques were used to train the neural network. The inputs to the network were samples of the desired synthesis pattern. The outputs are the array element excitations required to synthesize the desired pattern. Once trained, the network is used to simulate the W-L or D-C techniques. Various sector patterns and cosecant-type patterns (27 total) generated using W-L synthesis were used

to train the network. Desired pattern samples were then fed to the neural network. The outputs of the network were the simulated W-L excitations. A 20 element linear array was used. There were 41 input pattern samples with 40 output excitations (20 real parts, 20 imaginary). A comparison between the simulated and actual W-L techniques is shown for a triangular-shaped pattern. Dolph-Chebyshev is a different class of synthesis technique in that D-C is used for side lobe control as opposed to pattern shaping. The interesting thing about D-C synthesis is that the side lobes have the same amplitude. Five-element arrays were used. Again, 41 pattern samples were used for the input. Nine actual D-C patterns ranging from -10 dB to -30 dB side lobe levels were used to train the network. A comparison between simulated and actual D-C techniques for a pattern with -22 dB side lobe level is shown. The goal for this research was to evaluate the performance of neural network computing with antennas. Future applications will employ the backpropagation training algorithm to drastically reduce the computational complexity involved in performing EM compensation for surface errors in large space reflector antennas. Author

N93-16791*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.

STABILITY OF GENERALLY STIFFENED ANISOTROPIC NONCIRCULAR CYLINDERS **c39**

Nahil Atef Sobh *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 178-179 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Continuous filament grid-stiffened structure is a stiffening concept that combines structural efficiency and damage tolerance. However, finite element design of such structures against buckling is expensive due to the complexities of the structure. An analytical model of such a structure is developed using a penalty method (artificial springs) with a first order shear deformation theory (FSDT). The buckling analysis under combined loadings is done using energy method with a penalty/Rayleigh-Ritz technique. The penalty/Rayleigh-Ritz approach is computationally less demanding when compared to the finite element solution and mesh generation. Apart from the published research works on buckling of stiffened plates and shells by finite element and finite strips, research works on buckling of stiffened plates and shells utilize three different approaches; smeared, column, and discrete approaches. The discrete approach considers the discrete effects of the stiffeners in the buckling behavior by modeling stiffeners as line of bending (EI) and torsion (GJ) stiffnesses on panel skin. Some local deformations are lost when stiffeners are modeled as (EI) and (GJ) stiffeners. This approach becomes difficult in the case of plate stiffened in more than two directions. Most of the work done using the discrete approach involved the Classical Plate Theory (CLPT) rather than the FSDT. We report on our formulation of a discrete approach coupled with a penalty formulation and FSDT. Author

N93-16792*# Tuskegee Inst., AL. Dept. of Aerospace and Mechanical Engineering.

STUDIES ON SPECTRAL ANALYSIS OF RANDOMLY SAMPLED SIGNALS: APPLICATION TO LASER VELOCIMETRY DATA **c34**

David Sree *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 180-182 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Spectral analysis is very useful in determining the frequency characteristics of many turbulent flows, for example, vortex flows, tail buffeting, and other pulsating flows. It is also used for obtaining turbulence spectra from which the time and length scales associated with the turbulence structure can be estimated. These estimates, in turn, can be helpful for validation of theoretical/numerical flow turbulence models. Laser velocimetry (LV) is being extensively used in the experimental investigation of different types of flows, because of its inherent advantages; nonintrusive probing, high frequency response, no calibration requirements, etc. Typically, the output of an individual realization laser velocimeter is a set of randomly sampled velocity data. Spectral analysis of such data requires special techniques to obtain reliable estimates of correlation and power spectral density functions that describe the flow characteristics. FORTRAN codes for obtaining the autocorrelation and power spectral density estimates using the correlation-based slotting technique were developed. Extensive studies have been conducted on simulated first-order spectrum and sine signals to improve the spectral estimates. A first-order spectrum was chosen because it represents the characteristics of a typical one-dimensional turbulence spectrum. Digital prefiltering techniques, to improve the spectral estimates from randomly sampled data were applied. Studies show that the spectral estimates can be increased up to about five times the mean sampling rate. Author

N93-16793*# Washington Univ., Saint Louis, MO. Dept. of Civil Engineering.

MODE INTERACTION IN STIFFENED COMPOSITE SHELLS UNDER COMBINED MECHANICAL AND THERMAL LOADINGS **c39**

Srinivasan Sridharan *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 183-184 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Stiffened shells of various configurations fabricated out of composite materials find extensive applications in aircraft structures. Two distinctive modes of buckling dominate structural response of stiffened panels, viz. the short-wave local mode in which the shell skin buckles essentially between the stiffeners and the long-wave overall mode in which the shell skin buckles carrying the stiffeners with it. In optimized designs, the critical stresses corresponding to these modes of buckling would be close to each other. This leads to a nonlinear mode interaction which is recognized to be the principal cause of the failure of stiffened structures. If the structure is subjected to through-the-thickness thermal gradients, then large-wave bending effects would begin to occur well below the overall critical load and these would play the role of overall imperfections. The load carrying capacity would be significantly diminished as a result of interaction of local buckling with overall thermal distortions. The analysis of this problem using standard finite element techniques can be shown to be prohibitively expensive for design iterations. A concept which would greatly facilitate the analysis of mode interaction is advanced. We note that the local buckling occurs in a more or less periodic pattern in a structure having regular spacings of stiffeners. Thus it is a relatively simple matter to analyze the local buckling and the second order effects (which are essential for modeling postbuckling phenomena) using a unit cell of the structure. Once analyzed, these dormations are embedded in a shell element. Thus, a shell element could span several half-waves of local buckling and still be able to depict local buckling effects with requisite accuracy. A major consequence of the interaction of overall buckling/bending is the slow variation of the local buckling amplitude across the structure - the phenomenon of 'amplitude modulation' - and this is accounted for in the present model by letting the scaling parameter of the local mode vary according to a 'slowly varying' function. The construction of the analytical model involves essentially two stages and these are described briefly. Author

N93-16794*# Hampton Univ., VA. Dept. of Chemistry.

CHARACTERIZATION OF RADIATION-INDUCED DAMAGE IN HIGH PERFORMANCE POLYMERS BY ELECTRON PARAMAGNETIC RESONANCE IMAGING SPECTROSCOPY **c27**

Naushadalli K. Suleman *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 185-186 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

The potential for long-term human activity beyond the Earth's protective magnetosphere is limited in part by the lack of detailed information on the effectiveness and performance of existing structural materials to shield the crew and spacecraft from highly penetrating space radiations. The two radiations of greatest concern are high energy protons emitted during solar flares and galactic cosmic rays which are energetic ions ranging from protons to highly oxidized iron. Although the interactions of such high-energy radiations with matter are not completely understood at this time, the effects of the incident radiation are clearly expected to include the formation of paramagnetic spin centers via ionization and bond-scission reactions in the molecular matrices of structural materials. Since this type of radiation damage is readily characterized by Electron Paramagnetic Resonance (EPR) spectroscopy, the NASA Langley Research Center EPR system was repaired and brought on-line during the 1991 ASEE term. A major goal of the 1992 ASEE term was to adapt the existing core of the LaRC EPR system to meet the requirements for EPR Imaging--a powerful new technique which provides detailed information on the internal structure

of materials by mapping the spatial distribution of unpaired spin density in bulk media. Major impetus for this adaptation arises from the fact that information derived from EPRI complements other methods such as scanning electron microscopy which primarily characterize surface phenomena. The modification of the EPR system has been initiated by the construction of specially designed, counterwound Helmholtz coils which will be mounted on the main EPR electromagnet. The specifications of the coils have been set to achieve a static linear magnetic field gradient of 10 gauss/mm/amp along the principal (Z) axis of the Zeeman field. Construction is also in progress of a paramagnetic standard in which the spin distribution is known in all three dimensions. This sample will be used to assess the linearity of the magnetic field gradient and to ensure authentic image reconstruction. A second major task was to secure the computer capability to enable image reconstruction from projection data generated by the magnetic field gradients. To this end, commercially available and public domain software packages which perform inverse Fourier Transform and convoluted (filtered) back projection functions are being integrated into the existing EPR data processing system. Author

N93-16795*# Paul D. Camp Community Coll., Suffolk, VA. Dept. of Computer Information Systems.

DESKTOP COMPUTING INTEGRATION PROJECT **c61**

Robert L. Tureman, Jr. *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 187-188 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

The Desktop Computing Integration Project for the Human Resources Management Division (HRMD) of LaRC was designed to help division personnel use personal computing resources to perform job tasks. The three goals of the project were to involve HRMD personnel in desktop computing, link mainframe data to desktop capabilities, and to estimate training needs for the division. The project resulted in increased usage of personal computers by Awards specialists, an increased awareness of LaRC resources to help perform tasks, and personal computer output that was used in presentation of information to center personnel. In addition, the necessary skills for HRMD personal computer users were identified. The Awards Office was chosen for the project because of the consistency of their data requests and the desire of employees in that area to use the personal computer. Author

N93-16796*# Old Dominion Univ., Norfolk, VA.

MULTIDISCIPLINARY DESIGN OPTIMIZATION USING RESPONSE SURFACE ANALYSIS **c05**

Resit Unal *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 189-190 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Aerospace conceptual vehicle design is a complex process which involves multidisciplinary studies of configuration and technology options considering many parameters at many values. NASA Langley's Vehicle Analysis Branch (VAB) has detailed computerized analysis capabilities in most of the key disciplines required by advanced vehicle design. Given a configuration, the capability exists to quickly determine its performance and lifecycle cost. The next step in vehicle design is to determine the best settings of design parameters that optimize the performance characteristics. Typical approach to design optimization is experience based, trial and error variation of many parameters one at a time where possible combinations usually number in the thousands. However, this approach can either lead to a very long and expensive design process or to a premature termination of the design process due to budget and/or schedule pressures. Furthermore, one variable at a time approach can not account for the interactions that occur among parts of systems and among disciplines. As a result, vehicle design may be far from optimal. Advanced multidisciplinary design optimization (MDO) methods are needed to direct the search in an efficient and intelligent manner in order to drastically reduce the number of candidate designs to be evaluated. The payoffs in terms of enhanced performance and reduced cost are significant. A literature review yields two such advanced MDO methods used in aerospace design optimization; Taguchi methods and response surface methods. Taguchi methods provide a systematic and efficient method for design optimization for performance and cost. However, response surface method (RSM) leads to a better, more accurate exploration of the parameter space and to estimated optimum conditions with a small expenditure on experimental data. These two methods are described. Author

N93-16797*# California State Univ., Los Angeles. Dept. of Mechanical Engineering.

NAVIER-STOKES CALCULATION OF TRANSONIC FLOW PAST THE NTF 65-DEG DELTA WING **c02**

Chivey Wu *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 191-199 (For primary document see N93-16760 05-80)
Avail: CASI HC A02/MF A03

Viscous flow past a wind tunnel model of a 65-degree swept angle Delta wing at transonic speeds is being studied. The model was tested in the 8-foot cryogenic transonic wind tunnel at the National Transonic Facility. Aerodynamic forces and wing surface pressure data were obtained at various angles of attack, Mach numbers, and Reynold's numbers for four different leading edges of the wing. The objectives of the present investigation are: (1) to perform numerical modeling of the flow around the wing; (2) to validate the experimental data with a Navier-Stokes computational fluid dynamics code and vice versa; (3) to investigate the effects of the sting mount of the wing; (4) to evaluate the effects of leading edge radius on the flow; and (5) to explain the Reynold's number effect as indicated by the test data. Several computer programs were developed to define the surfaces of the wing, the four leading edges, and the sting mount. Based on these geometric databases, the surface grids of a single-block computational domain was generated interactively on the IRIS workstation using the GRIDGEN2D module of GRIDGEN. To refine the grids and to avoid excessive loss of grid points due to collapsed edges, a 9-block computational domain containing approximately 750,000 grid points was developed with the GRIDBLOCK module to replace the single-block grid. Author

N93-16798*# California Polytechnic State Univ., San Luis Obispo.

IMPROVEMENT IN THE CONTROL ASPECT OF LASER FREQUENCY STABILIZATION FOR SUNLITE PROJECT **c36**

Omar Zia *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1992 Sep. 1992 p 200-203 (For primary document see N93-16760 05-80)
Avail: CASI HC A01/MF A03

Flight Electronics Division of Langley Research Center is developing a spaceflight experiment called the Stanford University and NASA Laser In-Space Technology (SUNLITE). The objective of the project is to explore the fundamental limits on frequency stability using an FM laser locking technique on a Nd:YAG non-planar ring (free-running linewidth of 5 KHz) oscillator in the vibration free, microgravity environment of space. Compact and automated actively stabilized terahertz laser oscillators will operate in space with an expected linewidth of less than 3 Hz. To implement and verify this experiment, NASA engineers have designed and built a state of the art, space qualified high speed data acquisition system for measuring the linewidth and stability limits of a laser oscillator. In order to achieve greater stability and better performance, an active frequency control scheme requiring the use of a feedback control loop has been applied. In the summer of 1991, the application of control theory in active frequency control as a frequency stabilization technique was investigated. The results and findings were presented in 1992 at the American Control Conference in Chicago, and have been published in Conference Proceedings. The main focus was to seek further improvement in the overall performance of the system by replacing the analogue controller by a digital algorithm. Author

N93-17279*# Alabama Univ., Tuscaloosa.

1992 NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM

L. Michael Freeman, Charles R. Chappell, Frank Six, and Gerald R. Karr Dec. 1992 307 p
(Grant NGT-01-002-099)
(NASA-CR-184505; NAS 1.26:184505) Avail: CASI HC A14/MF A03

For the 28th consecutive year, a NASA/ASEE Summer Faculty Fellowship Program was conducted at the Marshall Space Flight Center (MSFC). The program was conducted by the University of Alabama and MSFC during the period June 1, 1992 through August 7, 1992. Operated under the auspices of the American Society for Engineering Education, the MSFC

program, was well as those at other centers, was sponsored by the Office of Educational Affairs, NASA Headquarters, Washington, DC. The basic objectives of the programs, which are the 29th year of operation nationally, are (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate and exchange ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of the participants' institutions; and (4) to contribute to the research objectives of the NASA centers. For individual titles, see N93-17280 through N93-17340.

N93-17280*# California State Polytechnic Univ., Pomona. Dept. of Chemical and Materials Engineering.

HEAT FLOW IN VARIABLE POLARITY PLASMA ARC WELDS c37

Amanie N. Abdelmessih *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 6 p (For primary document see N93-17279 05-80)

Avail: CASI HC A02/MF A03

The space shuttle external tank and the space station Freedom are fabricated by the variable polarity plasma arc (VPPA) welding. Heat sink effects (taper) are observed when there are irregularities in the work-piece configuration especially if these irregularities are close to the weld bead. These heat sinks affect the geometry of the weld bead, and in extreme cases they could cause defects such as incomplete fusion. Also, different fixtures seem to have varying heat sink effects. The objective of the previous, present, and consecutive research studies is to investigate the effect of irregularities in the work-piece configuration and fixture differences on the weld bead geometry with the ultimate objective to compensate automatically for the heat sink effects and achieve a perfect weld. Author

N93-17281*# Alabama Univ., Huntsville. Dept. of Industrial Engineering.

SYSTEMS ENGINEERING PROCESS AND ORGANIZATION ASSESSMENT c81

Robert G. Batson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The purpose of this report is to briefly summarize the results of an eight week assessment of NASA/MSFC Phase A and Phase B systems engineering processes, methodologies, and activities. Specifically, fourteen inconsistencies or weaknesses were identified and recommendations for corrective action were generated. A 1.5 hour briefing on these results was given in EL51 on 8-11-92; that documentation is available from the author or either NASA Colleague. Author

N93-17282*# Alabama A & M Univ., Huntsville. Dept. of Mathematics.

UPDATING AND EXPANDING THE LIBRARY OF MATERIALS ON NASA SPACELINK ELECTRONIC INFORMATION SYSTEM c82

Jean A. Blake *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 6 p (For primary document see N93-17279 05-80)

Avail: CASI HC A02/MF A03

NASA Spacelink, a proven resource medium, may be accessed over telephone lines or via the Internet by teachers or anyone with a computer or modem. It is a collection of historical and current information on NASA programs and activities. Included in this library is information on a variety of NASA programs, updates on Shuttle status, news releases, aeronautics, space exploration, classroom materials, NASA Educational Services, and computer programs and graphics. The material stored in Spacelink has found widespread use by teachers and others, and is being used to stimulate students, particularly in the area of aerospace science. Author

N93-17283*# Alabama Univ., Huntsville. Dept. of Mechanical and Aerospace Engineering.

DESIGN AND ANALYSIS OF SEALS FOR EXTENDED SERVICE LIFE c37

Mark V. Bower *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

Space Station Freedom is being developed for a service life of up to thirty years. As a consequence, the design requirements for the seals to be used are unprecedented. Full scale testing to assure the selected seals can satisfy the design requirements are not feasible. As an alternative, a sub-scale test program has been developed by MSFC to calibrate the analysis tools to be used to certify the proposed design. This research has been conducted in support of the MSFC Integrated Seal Test Program. The ultimate objective of this research is to correlate analysis and test results to qualify the analytical tools, which in turn, are to be used to qualify the flight hardware. This research is totally focused on O-rings that are compressed by perpendicular clamping forces. In this type of seal the O-ring is clamped between the sealing surfaces by loads perpendicular to the circular cross section. Author

N93-17284*# Jackson State Univ., MS. School of Science and Technology.

SHUTTLE FLIGHT EXPERIMENT PRELIMINARY PROPOSAL: DEMONSTRATION OF WELDING APPLICATIONS IN SPACE c37

William V. Brewer *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

In June 1991 work was initiated at MSFC on an end-effector for 'Robotic Assembly of Welded Truss Structures in Space'. The case for welded joint assembly on orbit was discussed in the 1991 SFFP Final Report 'D'. Data drawn from Aerobrake studies (supported by the ISAAC program) allowed the more detailed investigations that accompany a design with relatively concrete goals. This principle guides current efforts to develop scenarios that further demonstrate the utility of welding for space construction and/or repair. Author

N93-17285*# Columbia State Community Coll., TN. Dept. of Computer Information Systems.

INVESTIGATION OF RAINFALL DATA WITH REGARD TO LOW-LEVEL WIND FLOW REGIME FOR EAST CENTRAL FLORIDA c47

Joni Brooks *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

Previous research has been conducted to investigate the effect of the low-level wind region on summertime convective storms in the east central Florida area. These effects were described by analyzing the distribution of lightning flashes within classifications based on the low-level wind regime for the months June through September of 1987 to 1990. The present research utilizes the same classification strategy to study rainfall patterns for data gathered for the CaPE (Convection and Precipitation/Electrification Experiment) field program. The CaPE field program was conducted in east central Florida from July 8, 1991 to August 18, 1991. Author

N93-17286*# Mississippi State Univ., Mississippi State. Dept. of Industrial Engineering.

REQUIREMENTS FOR THE IMPLEMENTATION OF SCHEDULE REPAIR TECHNOLOGY IN THE EXPERIMENT SCHEDULING PROGRAM c66

Stanley F. Bullington *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The following list of requirements specifies the proposed revisions to the Experiment Scheduling Program (ESP2) which deal with schedule repair. These requirements are divided into those which are general in nature, those which relate to measurement and analysis functions of the software, those which relate specifically to conflict resolution, and those relating directly to the user interface. (This list is not a complete list of requirements for the user interface, but only a list of those schedule repair requirements which relate to the interface.) Some of the requirements relate only to uses of the software in real-time operations. Others are clearly for future versions of the software, beyond the upcoming revision. In either case, the fact will be clearly stated. Author

N93-17287*# Armstrong State Coll., Savannah, GA. Dept. of Computer Science.

A SECOND GENERATION EXPERT SYSTEM FOR CHECKING AND DIAGNOSING AXAF'S ELECTRIC POWER SYSTEM c33

Alex Bykat *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty

Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

AXAF - Advanced X-ray Astrophysics Facility - is a third NASA's great space observatory. Each of these observatories is intended to cover different parts of the electromagnetic spectrum (x-ray for AXAF) and to provide high resolution images of celestial sources in our universe. While the spacecraft is in orbit, the electric power system (EPS) performance is monitored via sensors measuring voltages, currents, pressures, and temperatures. The sensor data are sent from the spacecraft to the ground station as telemetry and analyzed on arrival. Monitoring, diagnosis and maintenance of such EPS is an arduous task which requires expertise and constant attention of the ground personnel. To help the ground crew in this task, much of it should be automated and delegated to expert systems, which draw engineer's attention to possible malfunctions and allows him to review the telemetry to determine the source of the trouble, diagnose the suspected fault and to propose a corrective action. Those systems are built on assumptions such as: (1) domain knowledge is available and can be represented as a set of rules; (2) domain knowledge is circumscribed, static, and monotonic; and (3) expert decision making can be emulated by a logical inference mechanism. Author

N93-17288*# Spelman Coll., Atlanta, GA. Dept. of Chemistry.
PREDICTION OF NONLINEAR OPTICAL PROPERTIES OF LARGE ORGANIC MOLECULES **c27**
Beatriz H. Cardelino *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

The preparation of materials with large nonlinear responses usually requires involved synthetic processes. Thus, it is very advantageous for materials scientists to have a means of predicting nonlinear optical properties. The prediction of nonlinear optical properties has to be addressed first at the molecular level and then as bulk material. For relatively large molecules, two types of calculations may be used, which are the sum-over-states and the finite-field approach. The finite-field method was selected for this research, because this approach is better suited for larger molecules. I.I.C.

N93-17289*# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Mechanical Engineering.
CFD ANALYSIS ON CONTROL OF SECONDARY LOSSES IN STME LOX TURBINES WITH ENDWALL FENCES **c34**
Mingking K. Chyu *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

The rotor blade in the newly designed LOX turbine for the future Space Transportation Main Engine (STME) has a severe flow turning angle, nearly 160 degrees. The estimated secondary loss in the rotor alone accounts for nearly 50 percent of the total loss over the entire stage. To reduce such a loss, one of the potential methods is to use fences attached on the turbine endwall (hub). As a prelude to examining the effects of endwall fence with actual STME turbine configuration, the present study focuses on similar issues with a different, but more generic, geometry - a rectangular duct with a 160-degree bend. The duct cross-section has a 2-to-1 aspect ratio and the radii of curvature for the inner and outer wall are 0.25 and 1.25 times the duct width, respectively. The present emphasis lies in examining the effects of various fence-length extending along the streamwise direction. The flowfield is numerically simulated using the FDNS code developed earlier by Wang and Chen. The FDNS code is a pressure based, finite-difference, Navier-Stokes equations solver. I.I.C.

N93-17290*# Alabama Univ., Huntsville. Dept. of Mathematical Sciences.
OPTIMAL TRAJECTORIES FOR ORBITAL TRANSFERS USING LOW AND MEDIUM THRUST PROPULSION SYSTEMS **c13**
Shannon S. Cobb *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

For many problems it is reasonable to expect that the minimum time solution is also the minimum fuel solution. However, if one allows the propulsion system to be turned off and back on, it is clear that these two solutions may differ. In general, high thrust transfers resemble the well-known impulsive transfers where the burn arcs are of very short duration. The low and medium thrust transfers differ in that their thrust acceleration levels yield longer burn arcs which will require more revolutions, thus making the low thrust transfer computational intensive. Here, we consider optimal low and medium thrust orbital transfers. Author

N93-17291*# State Univ. of New York, Stony Brook. Dept. of Mechanical Engineering Technology.
STME NOZZLE THERMAL ANALYSIS **c20**
Digendra K. Das *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

The current summer project has the objective of carrying out a detailed thermal analysis of the Space Transportation Main Engine (STME) nozzle. The design and development of the STME nozzle has been undertaken by Pratt and Whitney in collaboration with NASA/MSFC and DoD. The nozzle design has adopted film/convective cooling techniques. The turbine exhaust has been utilized as the coolant in the nozzle cooling system. I.I.C.

N93-17292*# Oklahoma Univ., Norman. School of Meteorology.
A PLAN FOR ACCURATE ESTIMATION OF DAILY AREA-MEAN RAINFALL DURING THE CAPE EXPERIMENT **c47**
Claude E. Duchon *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

The Convection and Precipitation/Electrification (CaPE) experiment took place in east central Florida from 8 July to 18 August, 1991. There were five research themes associated with CaPE. In broad terms they are: investigation of the evolution of the electric field in convective clouds, determination of meteorological and electrical conditions associated with lightning, development of mesoscale numerical forecasts (2-12 hr) and nowcasts (less than 2 hr) of convective initiation and remote estimation of rainfall. It is the last theme coupled with numerous raingage and streamgage measurements, satellite and aircraft remote sensing, radiosondes and other meteorological measurements in the atmospheric boundary layer that provide the basis for determining the hydrologic cycle for the CaPE experiment area. The largest component of the hydrologic cycle in this region is rainfall. An accurate determination of daily area-mean rainfall is important in correctly modeling its apportionment into runoff, infiltration and evapotranspiration. In order to achieve this goal a research plan was devised and initial analysis begun. The overall research plan is discussed with special emphasis placed on the adjustment of radar rainfall estimates to raingage rainfall. Author

N93-17293*# Alabama Univ., Huntsville. Dept. of Industrial and Systems Engineering.
EVALUATION AND RECOMMENDATIONS FOR WORK GROUP INTEGRATION WITHIN THE MATERIALS AND PROCESSES LAB **c81**
Phillip A. Farrington *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 6 p (For primary document see N93-17279 05-80)
Avail: CASI HC A02/MF A03

The goal of this study was to evaluate and make recommendations for improving the level of integration of several work groups within the Materials and Processes Lab at the Marshall Space Flight Center. This evaluation has uncovered a variety of projects that could improve the efficiency and operation of the work groups as well as the overall integration of the system. In addition, this study provides the foundation for specification of a computer integrated manufacturing test bed environment in the Materials and Processes Lab. Author

N93-17294*# Alabama A & M Univ., Huntsville. Dept. of Civil Engineering.
A STUDY OF THE LUTE METERING STRUCTURE **c39**
James W. Foreman *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document

see N93-17279 05-80)
Avail: CASI HC A01/MF A03

Two Metering Structure configurations were investigated. The first case was the traditional style metering structure which is larger than the outside diameter of the primary mirror. The second case investigated was the center support concept in which the outside diameter of the structure is less than the inside diameter of the primary mirror. Beryllium was used as the baseline material for this study. Four other materials were considered as candidates for the metering structure. These materials are: Graphite Epoxy, Aluminum, Titanium, and Invar. The loading conditions used for this study were estimated to be: Quasi Static: 6.0 G (all three directions); and Random Vibration: 30.0 G (applied 1 axis at a time). Taking advantage of symmetry, it was necessary to apply the lateral loading to only one axis. These loads were applied to both concepts and to all material configurations. The loadings as described above were based on the best available information and is felt to be adequate for this study since it was consistently used for all configurations. A load factor 2.00 was applied to both quasi static and random vibration loads. The allowable stresses are conservatively based yield strength of the material, except for the struts which are controlled by elastic stability. The stresses determined from each individual loading direction were conservatively combined by the absolute sum method. Author

N93-17295*# Alabama Univ., Huntsville. College of Engineering.
HYBRID ROCKET PERFORMANCE **c20**
Robert A. Frederick, Jr. *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

A hybrid rocket is a system consisting of a solid fuel grain and a gaseous or liquid oxidizer. Figure 1 shows three popular hybrid propulsion cycles that are under current consideration. NASA MSFC has teamed with industry to test two hybrid propulsion systems that will allow scaling to motors of potential interest for Titan and Atlas systems, as well as encompassing the range of interest for SEI lunar ascent stages and National Launch System Cargo Transfer Vehicle (NLS CTV) and NLS deorbit systems. Hybrid systems also offer advantages as moderate-cost, environmentally acceptable propulsion system. The objective of this work was to recommend a performance prediction methodology for hybrid rocket motors. The scope included completion of: a literature review, a general methodology, and a simplified performance model. Author

N93-17296*# Capitol Coll., Laurel, MD. Dept. of Mathematics and Computer Engineering.
GUIDE TO OBJECT-ORIENTED ANALYSIS AND DESIGN **c61**
Harry C. Harrison *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

The purpose of this guide is to provide Marshall Space Flight Center personnel with guidelines for the use of object-oriented analysis and design and to describe how it can be accomplished within the framework of existing development directives, including the Software Development Plan. It is not intended as a detailed tutorial. The reader is referred to the Coad and Yourdon texts in the References. Author

N93-17297*# Auburn Univ., AL. Dept. of Aerospace Engineering.
EXPERIMENTAL INVESTIGATION OF A SIMULATED LOX INJECTOR FLOW FIELD AND OTHER NONINTRUSIVE MEASUREMENT EFFORTS **c20**
Roy J. Hartfield, Jr. *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

Efforts to improve the characteristics of fuel-oxidizer mixing in liquid rocket combustors have lead to a swirl element design for a liquid oxygen injector which is being considered for use on the STME. For the design which is the subject of this investigation, the oxygen enters the injector element perpendicular to the injector axis and nearly tangent to the circular injector wall. This swirl element is at one end of a tube and the injector exit is at the other. This geometric configuration creates a plume in the shape of a conical sheet. This sheet is either primarily contiguous liquid or droplets depending on the pressure drop in the injector and the distance from the injector exit. Probe-based devices such as two-dimensional grid patternators have been used to investigate simulated LOX injector flow fields (Hulka). The primary work described herein is an effort to use optical techniques to investigate the plume of a swirl injector element. For this investigation, a high pressure (500 psig) cold flow test facility was constructed. Water was used as the LOX simulate and air pressure was used to drive the injector flow field. Laser-induced fluorescence (LIF) from dye seeded into the water was used to obtain quantitative measurements of the time-averaged water concentration distribution in the plume. Scattered laser light and LIF were used for time averaged plume visualization and scattered light from a strobe with a 1 microsecond pulse was used for time-resolved plume visualization. During the Summer Faculty Fellowship for which this report was developed, an additional effort, unrelated to the swirl injector investigation, was made to resolve fluctuations in the combustion product composition in the exhaust of a hybrid rocket motor. A brief description of this effort is included herein. Author

N93-17298*# Cincinnati Univ., OH. Dept. of Electrical and Computer Engineering.
MODELING FOR HEALTH MONITORING AND CONTROL WITH APPLICATIONS TO THE SPACE TRANSPORTATION MAIN ENGINE **c20**
Arthur J. Helmicki *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

The work reported herein represents a continuation of work begun at MSFC during the 1991 NASA/ASEE Summer Faculty Fellowship Program. During this period, the author proposed and studied a paradigm for the analysis and synthesis of Integrated Health Monitoring and Control Systems (IHMCS) for rocket engines. This work was motivated by NASA's desire to develop advanced propulsion systems which could operate with increased cost. The Space Transportation Main Engine (STME) whose function it is to provide primary thrust for the National Launch System (NLS) family of vehicles is a primary example of this trend. Author

N93-17299*# Alabama Univ., Huntsville. Dept. of Aerospace Engineering.
POST-IMPACT BEHAVIOR OF COMPOSITE SOLID ROCKET MOTOR CASES **c20**
Alton L. Highsmith *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

In recent years, composite materials have seen increasing use in advanced structural applications because of the significant weight savings they offer when compared to more traditional engineering materials. The higher cost of composites must be offset by the increased performance that results from reduced structural weight if these new materials are to be used effectively. At present, there is considerable interest in fabricating solid rocket motor cases out of composite materials, and capitalizing on the reduced structural weight to increase rocket performance. However, one of the difficulties that arises when composite materials are used is that composites can develop significant amounts of internal damage during low velocity impacts. Such low velocity impacts may be encountered in routine handling of a structural component like a rocket motor case. The ability to assess the reduction in structural integrity of composite motor cases that experience accidental impacts is essential if composite rocket motor cases are to be certified for manned flight. The study described herein was an initial investigation of damage development and reduction of tensile strength in an idealized composite subjected to low velocity impacts. Author

N93-17300*# Auburn Univ., AL. Dept. of Electrical Engineering.
NUMERICAL METHODS FOR THE ANALYSIS OF SAMPLED-DATA SYSTEMS AND FOR THE COMPUTATION OF SYSTEM ZEROS **c64**
A. Scottedward Hodel *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

MARSYAS is a computer-aided control system design package for the

simulation and analysis of dynamic systems. In the summer of 1991 MARSYAS was updated to allow for the analysis of sampled-data systems in terms of frequency response, stability, etc. This update was continued during the summer of 1992 in order to extend further MARSYAS commands to the study of sampled-data systems. Further work was done to examine the computation of OPENAT transfer functions, root-locii and w-plane frequency response plots. Author

N93-17301*# Alabama Univ., Huntsville. Dept. of Management and Marketing.

SOME EFFECTS OF TIME USAGE PATTERNS ON THE PRODUCTIVITY OF ENGINEERS **c81**

Conrad N. Jackson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The performance of the 1500+ engineers at MSFC is critical to the Center's mission. Worker's performance, however, is a variable affected by ability, motivation, role understanding, and other factors. Managing subordinates' performance is a great challenges to managers. Special challenges confront the managers of engineers because engineers often work with general goals, long deadlines, and considerable autonomy. The productivity of a team or branch is a function of the productivity of each of its members. While many managers have personal theories about how to run their work group, surprisingly little systematic scientific knowledge exerts about the effects of various factors on engineers' productivity. This study is intended to help lay the foundation for such a program of research. Author

N93-17302*# Auburn Univ., AL. Dept. of Mechanical Engineering.

SPACE ENVIRONMENTAL EFFECTS ON POLYMERS AND COMPOSITES **c27**

Bor Z. Jang *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The response of polymers and polymer-based composites to the space environment is being investigated. A wide range of materials are covered in this study, including elastometer seals for Space Station Freedom, polymer films for thermal control, and composites for space structural elements. Space environmental agents of concern include atomic oxygen, thermal cycling, space debris impacts, UV, charged particles and other forms of high-energy radiation. This ambitious project is potentially a multi-year research effort and the success of such a project could be expected to have a profound impact on the design of future space-based structures. The research goal of this first Summer is to identify the priority areas of research and to carry out the initial phase task so that a collaborative research can proceed smoothly and fruitfully in the near future. Author

N93-17303*# Alabama Univ., Huntsville. Dept. of Biological Sciences.

GROUND TESTING OF BIOCONVECTIVE VARIABLES SUCH AS MORPHOLOGICAL CHARACTERIZATIONS AND MECHANISMS WHICH REGULATE MACROSCOPIC PATTERNS **c51**

Adriel D. Johnson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 3 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

Conditions simulating low- and high-gravity, reveal changes in macroscopic pattern formation in selected microorganisms, but whether these structures are gravity dependent is not clear. Two theories have been identified in the fluid dynamics community which support macroscopic pattern formation. The first one is gravity dependent (fluid density models) where small concentrated regions of organisms sink unstably, and the second is gravity independent (wave reinforcement theory) where organisms align their movements in concert, such that either their swimming strokes beat in phase or their vortices entrain neighbors to follow parallel paths. Studies have shown that macroscopic pattern formation is consistent with the fluid density models for protozoa and algae and wave reinforcement hypothesis for caprine spermatozoa. Author

N93-17304*# Indiana Univ. of Pennsylvania, Indiana, PA. Dept. of Physics.

ENERGETICS AND STRUCTURAL PROPERTIES OF TWIST GRAIN BOUNDARIES IN Cu **c26**

Majid Karimi *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

Structural and energetics properties of atoms near a grain boundary are of great importance from theoretical and experimental standpoints. From various experimental work it is concluded that diffusion at low temperatures at polycrystalline materials take place near grain boundary. Experimental and theoretical results also indicate changes of up to 70 percent in physical properties near a grain boundary. The Embedded Atom Method (EAM) calculations on structural properties of Au twist grain boundaries are in quite good agreement with their experimental counterparts. The EAM is believed to predict reliable values for the single vacancy formation energy as well as migration energy. However, it is not clear whether the EAM functions which are fitted to the bulk properties of a perfect crystalline solid can produce reliable results on grain boundaries. One of the objectives of this work is to construct the EAM functions for Cu and use them in conjunction with the molecular static simulation to study structures and energetics of atoms near twist grain boundaries in Cu. This provides tests of the EAM functions near a grain boundary. In particular, we determine structure, single vacancy formation energy, migration energy, single vacancy activation energy, and interlayer spacing as a function of distance from grain boundary. Our results are compared with the available experimental and theoretical results from grain boundaries and bulk. Author

N93-17305*# Bronx Community Coll., NY. Dept. of Engineering Technologies.

USING SOFTWARE METRICS AND SOFTWARE RELIABILITY MODELS TO ATTAIN ACCEPTABLE QUALITY SOFTWARE FOR FLIGHT AND GROUND SUPPORT SOFTWARE FOR AVIONIC SYSTEMS **c61**

Stella Lawrence *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 6 p (For primary document see N93-17279 05-80)

Avail: CASI HC A02/MF A03

This paper is concerned with methods of measuring and developing quality software. Reliable flight and ground support software is a highly important factor in the successful operation of the space shuttle program. Reliability is probably the most important of the characteristics inherent in the concept of 'software quality'. It is the probability of failure free operation of a computer program for a specified time and environment. Author

N93-17306*# Florida Univ., Gainesville. Dept. of Astronomy.

AN ALGORITHM TO QUANTIFY THE PERFORMANCE OF THE JOVE PROGRAM **c61**

George Lebo *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 3 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

A proposal to the Hubble Space Institute from Hunter Waite, Southwest Research Institute, James Green, GSFC, and the author will be written to examine potential correlations between the Jovian auroral activity as recently discovered by the Hubble Space Telescope UV imaging experiment and Jupiter's decametric radio waves as recorded by two ground-base radio observatories; one at the University of Florida and the other in Japan. Author

N93-17307*# Alabama Univ., Huntsville. Dept. of Electrical Engineering.

ADAPTIVE OPTICS FOR LASER POWER BEAMING **c74**

Robert P. Leland *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

It has been proposed to use a high energy pulsed laser to beam power into space for satellites or a lunar base. The effects of atmospheric transmission are critical to such a system. Thermal blooming in the atmosphere can cause the beam to spread rapidly. Atmospheric turbulence

can cause beam bending or beam spreading, resulting in the loss of transmitted energy that fails to hit the target receiver. Author

N93-17308*# Mississippi State Univ., Mississippi State. Dept. of Physics and Astronomy.
STRUCTURE IN GAMMA RAY BURST TIME PROFILES: STATISTICAL ANALYSIS 1 **c93**
John Patrick Lestrade *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

Since its launch on April 5, 1991, the Burst And Transient Source Experiment (BATSE) has observed and recorded over 500 gamma-ray bursts (GRB). The analysis of the time profiles of these bursts has proven to be difficult. Attempts to find periodicities through Fourier analysis have been fruitless except one celebrated case. Our goal is to be able to qualify the observed time-profiles structure. Before applying this formation to bursts, we have tested it on profiles composed of random Poissonian noise. This paper is a report of those preliminary results. Author

N93-17309*# Alabama Univ., Huntsville. Dept. of Aerospace Engineering.
DIRECTIONS FOR FUTURE EARTH-TO-ORBIT VEHICLES **c16**
James A. Martin *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

NASA is currently assessing several programmatic possibilities. The desire is to maintain the current capability for transportation to orbit provided by the Space Shuttle and the existing fleet of commercial vehicles, develop the Space Station Freedom, and initiate a new program of exploration of the Moon and Mars, called the Space Exploration Initiative (SEI). At the same time, the NASA budget is likely to be held to current levels. Cost estimates indicate that it will not be possible to satisfy all the goals without cost reductions. One of the concepts being considered for cost reduction is to replace the Space Shuttle and existing commercial vehicles with a new set of vehicles called the National Launch System (NLS). Several concepts have been studied, but none of the concepts studied to date provides the desired combination of cost/flight reduction, acceptable development cost, and technology readiness. An additional goal is to provide a path to grow the NLS capability into a heavy-lift capability for SEI missions. Author

N93-17310*# Alabama Univ., Huntsville. Dept. of Industrial Engineering.
DEVELOPMENT OF A PROTOTYPE INTERACTIVE LEARNING SYSTEM USING MULTI-MEDIA TECHNOLOGY FOR MISSION INDEPENDENT TRAINING PROGRAM **c53**
Jack E. Matson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 6 p (For primary document see N93-17279 05-80)
Avail: CASI HC A02/MF A03

The Spacelab Mission Independent Training Program provides an overview of payload operations. Most of the training material is currently presented in workbook form with some lecture sessions to supplement selected topics. The goal of this project was to develop a prototype interactive learning system for one of the Mission Independent Training topics to demonstrate how the learning process can be improved by incorporating multi-media technology into an interactive system. This report documents the development process and some of the problems encountered during the analysis, design, and production phases of this system. Author

N93-17311*# Berry Coll., Mount Berry, GA. Dept. of Physics.
MULTIPATH EFFECTS IN A GLOBAL POSITIONING SATELLITE SYSTEM RECEIVER **c04**
Malcolm W. McDonald *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

This study, as a part of a large continuing investigation being conducted by the Communications Systems Branch of the Information and Electronic Systems Laboratory at the Marshall Space Flight Center, was undertaken to explore the multipath response characteristics of a particular Global Positioning Satellite (GPS) receiver which was available in the laboratory at the beginning and throughout the entirety of the study, and to develop a suitable regime of experimental procedure which can be applied to other state-of-the-art GPS receivers in the larger investigation. Author

N93-17312*# Fisk Univ., Nashville, TN. Dept. of Physics.
THE IONOSPHERE AS A GAMMA RAY BURST DETECTOR **c46**
Charles H. McGruder, III *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

Unlike all man made detectors, which are only sensitive to relative narrow regions of the electromagnetic spectrum, the ionosphere is practically a perfect detector for high energy radiation because it absorbs all radiation from the far-ultraviolet to the higher energy gamma-rays. Therefore, it may be possible to employ the terrestrial atmosphere as a detector of high energy celestial photons. As early as the 1940's solar flares were detected by the disturbance they caused to the ionosphere. The VLF (3 - 30 kHz) approach for detecting ionospheric disturbances is based on the following physical circumstance: celestial high energy radiation ionizes the atoms of the earth's ionosphere leading to the production of free electrons. These free electrons influence the propagation of electromagnetic waves. By studying the phase and amplitude changes of VLF radio wave propagating in the earth-ionosphere waveguide, it was hoped to ascertain the electron density in these regions and draw conclusions about the celestial radiation which caused them. To detect gamma-ray bursts, two conditions for the optimal detection are: (1) large zenith angle; and (2) alignment of burst and propagation path. I.I.C.

N93-17313*# New Mexico State Univ., University Park. Dept. of Astronomy.
CORRELATED OPTICAL OBSERVATIONS WITH BATSE/CGRO ON SCO X-1 **c89**
Bernard McNamara *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

The Burst and Transient Source Experiment (BATSE) instrument on the Compton Gamma-Ray Observatory consists of two banks of eight instruments referred to as the Large Area Detectors (LADs) and the Spectroscopic Detectors (SDs). Each LAD crystal is 50.8 cm in diameter by 1.27 cm thick while for a SD these values are 12.7 cm in diameter by 7.62 cm in diameter. Both the LADs and SDs are NaI(Tl) scintillation detectors. The LADs and SDs are situated on the CGRO spacecraft so as to provide all sky coverage for both sets of detectors. The SDs have the ability to measure energies in the 8-16 keV range whereas the minimum energy at which the LADs operate is near 20 keV. SCO X-1 is the brightest continuous x-ray source in the sky. It is believed to consist of a low mass star orbiting and transferring mass onto a neutron star. It is representative of a class of similar objects referred to as low mass x-ray binaries (LMXB). Because SCO X-1 serves as the prototype of this class of x-ray emitters and since its detectable emission is so large, it warrants extended study. One of the most fruitful techniques of studying a LMXB system is by simultaneously monitoring its emission at a variety of different wavelengths. These correlated datasets can be used to probe the source environment, investigate emission mechanisms, and examine the mass transfer process itself. In principle, the BATSE SDs have the capability of providing a nearly continuous 8-16 keV record of SCO X-1 activity. The aim of this study was to investigate the feasibility of using the BATSE SDs along with simultaneous optical measurements to study this source. Author

N93-17314*# Community Coll. of Northeast Misssissippi, Senatobia. Division of Mathematics and Science.
PROBLEMS INVOLVING COMBINED LOADING **c39**
Lunelle Miller *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

The first problem was to determine the capability of a ground support equipment (GSE) rack knee bracket for handling a spacelab rack. The geometric center of gravity was calculated for the upper and lower part of the rack and found to be in the center of gravity's allowable envelope.

The second problem was to determine the exact margin of safety for an axial load and a shear load on a bolt. The equation for failure is axial load squared plus shear load cubed equal one. The third problem was to simplify an expression for stress on a generic non-symmetrical bolt configuration to a form familiar to 'bolt people'. The final problem was the structural analysis of the spacelab rack corner posts. I.I.C.

N93-17315*# Auburn Univ., AL. Dept. of Computer Science and Engineering.

A PROCESS FOR PROTOTYPING ONBOARD PAYLOAD DISPLAYS FOR SPACE STATION FREEDOM **c12**

Loretta A. Moore *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

Significant advances have been made in the area of Human-Computer Interface design. However, there is no well-defined process for going from user interface requirements to user interface design. Developing and designing a clear and consistent user interface for medium to large scale systems is a very challenging and complex task. The task becomes increasingly difficult when there is very little guidance and procedures on how the development process should flow from one stage to the next. Without a specific sequence of development steps each design becomes difficult to repeat, to evaluate, to improve, and to articulate to others. This research contributes a process which identifies the phases of development and products produced as a result of each phase for a rapid prototyping process to be used to develop requirements for the onboard payload displays for Space Station Freedom. The functional components of a dynamic prototyping environment in which this process can be carried out is also discussed. Some of the central questions which are answered here include: How does one go from specifications to an actual prototype? How is a prototype evaluated? How is usability defined and thus measured? How do we use the information from evaluation in redesign of an interface? and Are there techniques which allow for convergence on a design? Author

N93-17316*# Alabama Univ., Huntsville. Dept. of Industrial Engineering.

DEVELOPMENT OF VENDOR EVALUATION CRITERIA AND POST-IMPLEMENTATION CONSIDERATIONS FOR MSFC CENTER-WIDE EXECUTIVE INFORMATION SYSTEM **c82**

Gary P. Moynihan *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

In June 1991, the MITRE Corporation submitted a series of recommendations as part of a Marshall Space Flight Center (MSFC) Management Information System Requirements Study, initiated by the Information Systems Office (ISO). A major recommendation of the study was to develop an Executive Information System (EIS) for MSFC executives. ISO was directed, by center management, to proceed with the development of a Center-Wide Executive Information System. Existing EIS prototypes, developed by the Space Shuttle Projects Office and the Payload Projects Office, were reviewed. These existing MSFC prototypes were considered not to encompass the required functionality needed on a center-wide basis. A follow-up study by MITRE provided top-level system requirements. These were later incorporated into a final requirements specification document by Boeing Computer Support Services. Author

N93-17317*# Naval Postgraduate School, Monterey, CA. Dept. of Physics.

ON THE CONSEQUENCES OF BI-MAXWELLIAN PLASMA DISTRIBUTIONS FOR PARALLEL ELECTRIC FIELDS **c33**

Richard C. Olsen *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The objective is to use the measurements of the equatorial particle distributions to obtain the parallel electric field structure and the evolution of the plasma distribution function along the field line. Appropriate uses of kinetic theory allows us to use the measured (and inferred) particle distributions to obtain the electric field, and hence the variation on plasma density along the magnetic field line. The approach, here, is to utilize the adiabatic invariants, and assume the plasma distributions are in equilibrium. I.I.C.

N93-17318*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.

SIMULATION OF CRYOGENIC TURBOPUMP ANNULAR SEALS **c37**

Alan B. Palazzolo *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The goal of the current work is to develop software that can accurately predict the dynamic coefficients, forces, leakage and horsepower loss for annular seals which have a potential for affecting the rotordynamic behavior of the pumps. The fruit of last year's research was the computer code SEALPAL which included capabilities for linear tapered geometry, Moody friction factor and inlet pre-swirl. This code produced results which in most cases compared very well with check cases presented in the literature. TAMUSEAL Icode, which was written to improve SEALPAL by correcting a bug and by adding more accurate integration algorithms and additional capabilities, was then used to predict dynamic coefficients and leakage for the NASA/Pratt and Whitney Alternate Turbopump Development (ATD) LOX Pump's seal. I.I.C.

N93-17319*# Georgia Southwestern Coll., Americus. Dept. of Geology and Physics.

THE KAPPA DISTRIBUTION AS A VARIATIONAL SOLUTION FOR AN INFINITE PLASMA **c75**

Michael J. Pangia *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

Pangia postulated that the preferred state of a single component infinite plasma is the one that will change the least when perturbed. The plasma distribution of such a state would maximize the plasma wave damping rate, or minimizing gamma where negative gamma is the damping rate. The present study continues from the idea developed by Pangia to determine what distribution function maximizes the damping rate. I.I.C.

N93-17320*# Florida Univ., Gainesville. Dept. of Physics.

STUDIES OF THE CHARGING OF A THIN DUST LAYER IN A PLASMA **c75**

Lennart R. Peterson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

When an infinite plane layer of dust having a number-density profile normal to the plane is exposed to an ambient e(sup -), p(sup +) plasma, one can imagine the features of the charging process near the layer boundary. If the e(sup -), p(sup +) temperatures are equal, and the B field is normal to the dust layer, the controlling factor is the large electron relative to proton speeds. Since the collision rate between plasma particles of number density n and speed v and an uncharged dust grain of radius a is estimated as the product n v pi a(exp 2), electrons dominate the charging process. The outer edge of the layer charges negatively, setting up an electrical potential that inhibits penetration of electrons into the layer and at the same time accelerates protons inward. Interior to the outer negative region then, one would expect many energetic protons compared to a reduced number of electrons from the ambient plasma. Charge imbalances are bound to arise, but the details are not so easy to deduce from simple arguments. These details are the subject of the present study. Author

N93-17321*# West Virginia Inst. of Tech., Montgomery. Dept. of Electrical Engineering.

SEDS1 MISSION SOFTWARE VERIFICATION USING A SIGNAL SIMULATOR **c61**

William E. Pierson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The first flight of the Small Expendable Deployer System (SEDS1) is schedule to fly as the secondary payload of a Delta 2 in March, 1993. The objective of the SEDS1 mission is to collect data to validate the

concept of tethered satellite systems and to verify computer simulations used to predict their behavior. SEDS1 will deploy a 50 lb. instrumented satellite as an end mass using a 20 km tether. Langley Research Center is providing the end mass instrumentation, while the Marshall Space Flight Center is designing and building the deployer. The objective of the experiment is to test the SEDS design concept by demonstrating that the system will satisfactorily deploy the full 20 km tether without stopping prematurely, come to a smooth stop on the application of a brake, and cut the tether at the proper time after it swings to the local vertical. Also, SEDS1 will collect data which will be used to test the accuracy of tether dynamics models used to stimulate this type of deployment. The experiment will last about 1.5 hours and complete approximately 1.5 orbits. Radar tracking of the Delta II and end mass is planned. In addition, the SEDS1 on-board computer will continuously record, store, and transmit mission data over the Delta II S-band telemetry system. The Data System will count tether windings as the tether unwinds, log the times of each turn and other mission events, monitor tether tension, and record the temperature of system components. A summary of the measurements taken during the SEDS1 are shown. The Data System will also control the tether brake and cutter mechanisms. Preliminary versions of two major sections of the flight software, the data telemetry modules and the data collection modules, were developed and tested under the 1990 NASA/ASEE Summer Faculty Fellowship Program. To facilitate the debugging of these software modules, a prototype SEDS Data System was programmed to simulate turn count signals. During the 1991 summer program, the concept of simulating signals produced by the SEDS electronics systems and circuits was expanded and more precisely defined. During the 1992 summer program, the SEDS signal simulator was programmed to test the requirements of the SEDS Mission software, and this simulator will be used in the formal verification of the SEDS Mission Software. The formal test procedures specification was written which incorporates the use of the signal simulator to test the SEDS Mission Software and which incorporates procedures for testing the other major component of the SEDS software, the Monitor Software.

Author

N93-17322*# California State Univ., Fullerton. Dept. of Civil Engineering.

RELIABILITY ANALYSIS OF EXTERNAL TANK ATTACK RING (ETA) **c38**

Chandra S. Putcha *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The present study is restricted to External Tank Attachment Rings (ETA), but the concepts discussed are general in nature and can be applied to any structural component. The objective of this research work is to use some of the existing probabilistic methods to calculate the reliability of ETA Rings at various critical sections for the limit state of stress. This is done both in terms of the traditional probability of failure and reliability levels as well as the well known safety indices (beta) which have become a commonly accepted measure of safety. I.I.C.

N93-17323*# Alabama Univ., Tuscaloosa. Dept. of Industrial Engineering.

EMERGENCY EGRESS REQUIREMENTS FOR CAUTION AND WARNING, LOGISTICS, MAINTENANCE, AND ASSEMBLY STAGE MB-6 OF SPACE STATION FREEDOM **c18**

Paul S. Ray *In its* 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The safety and survival of the crewmembers has been the prime concern of NASA. Previous studies have been conducted mainly for emergencies occurring during the operating mode of the fully assembled Station. The present study was conducted to evaluate the emergency requirements for the caution and warning, logistics, maintenance, and assembly stage MB-6 of the Station in space. Effective caution and warning is essential to achieve safe egress in emergencies. In order to survive a long period in space, the safety and emergency requirements for maintenance, logistics, and extravehicular assembly operation in space must be met. Author

N93-17324*# Marquette Univ., Milwaukee, WI. Dept. of Electrical and Computer Engineering.

ANALYSIS OF WAVES IN SPACE PLASMA (WISP) NEAR FIELD SIMULATION AND EXPERIMENT **c75**

James E. Richie *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The WISP payload scheduler for a 1995 space transportation system (shuttle flight) will include a large power transmitter on board at a wide range of frequencies. The levels of electromagnetic interference/electromagnetic compatibility (EMI/EMC) must be addressed to insure the safety of the shuttle crew. This report is concerned with the simulation and experimental verification of EMI/EMC for the WISP payload in the shuttle cargo bay. The simulations have been carried out using the method of moments for both thin wires and patches to stimulate closed solids. Data obtained from simulation is compared with experimental results. An investigation of the accuracy of the modeling approach is also included. The report begins with a description of the WISP experiment. A description of the model used to simulate the cargo bay follows. The results of the simulation are compared to experimental data on the input impedance of the WISP antenna with the cargo bay present. A discussion of the methods used to verify the accuracy of the model is shown to illustrate appropriate methods for obtaining this information. Finally, suggestions for future work are provided. Author

N93-17325*# Pittsburgh State Univ., KS. Dept. of Engineering Technology.

INDUSTRY SURVEY OF SPACE SYSTEM COST BENEFITS FROM NEW WAYS OF DOING BUSINESS **c83**

Russell L. Rosmait *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 3 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The cost of designing, building and operating space system hardware has always been expensive. Small quantities of specialty parts escalate engineering design, production and operations cost. Funding cutbacks and shrinking revenues dictate aggressive cost saving programs. NASA's highest priority is providing economical transportation to and from space. Over the past three decades NASA has seen technological advances that provide grater efficiencies in designing, building, and operating of space system hardware. As future programs such as NLS, LUTE and SEI begin, these greater efficiencies and cost savings should be reflected in the cost models. There are several New Ways Of Doing Business (NWODB) which, when fully implemented will reduce space system costs. These philosophies and/or culture changes are integrated in five areas: (1) More Extensive Pre-Phase C/D & E, (2) Multi Year Funding Stability, (3) Improved Quality, Management and Procurement Processes, (4) Advanced Design Methods, and (5) Advanced Production Methods. Following is an overview of NWODB and the Cost Quantification Analysis results using an industry survey, one of the four quantification techniques used in the study. The NWODB Cost Quantification Analysis is a study performed at Marshall Space Flight Center by the Engineering Cost Group, Applied Research Incorporated and Pittsburg State University. This study took place over a period of four months in mid 1992. The purpose of the study was to identify potential NWODB which could lead to improved cost effectiveness within NASA and to quantify potential cost benefits that might accrue if these NWODB were implemented. Author

N93-17326*# Alabama Univ., Tuscaloosa. Dept. of Engineering Mechanics.

DESIGN OF A WELDED JOINT FOR ROBOTIC, ON-ORBIT ASSEMBLY OF SPACE TRUSSES **c37**

William K. Rule *In its* 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

In the future, some spacecraft will be so large that they must be assembled on-orbit. These spacecraft will be used for such tasks as manned missions to Mars or used as orbiting platforms for monitoring the Earth or observing the universe. Some large spacecraft will probably consist of planar truss structures to which will be attached special purpose,

self-contained modules. The modules will most likely be taken to orbit fully outfitted and ready for use in heavy-lift launch vehicles. The truss members will also similarly be taken to orbit, but most unassembled. The truss structures will need to be assembled robotically because of the high costs and risks of extra-vehicular activities. Some missions will involve very large loads. To date, very few structures of any kind have been constructed in space. Two relatively simple trusses were assembled in the Space Shuttle bay in late 1985. Here the development of a design of a welded joint for on-orbit, robotic truss assembly is described. Mechanical joints for this application have been considered previously. Welded joints have the advantage of allowing the truss members to carry fluids for active cooling or other purposes. In addition, welded joints can be made more efficient structurally than mechanical joints. Also, welded joints require little maintenance (will not shake loose), and have no slop which would cause the structure to shudder under load reversal. The disadvantages of welded joints are that a more sophisticated assembly robot is required, weld flaws may be difficult to detect on-orbit, the welding process is hazardous, and welding introduces contamination to the environment. In addition, welded joints provide less structural damping than do mechanical joints. Welding on-orbit was first investigated aboard a Soyuz-6 mission in 1969 and then during a Skylab electron beam welding experiment in 1973. A hand held electron beam welding apparatus is currently being prepared for use on the MIR space station. Presently, Marshall Space Flight Center is evaluating processes appropriate for on-orbit welding. A low gravity environment has been found to have very minor effects on the welding processes appropriate for this application. This is based on tests run on-orbit as well as low gravity environments achieved by flying aircraft in parabolic trajectories. It appears that a modified form of gas tungsten arc welding (GTAW) will be most appropriate for welding together structures on-oribt. The process has been modified to work in a vacuum by providing gas to the arc zone by means of a hollow tungsten electrode with special shielding. A commercial tube welding head has been successfully modified for use on-orbit with a gas leakage rate of approximately 2.5 liters/min. To develop as realistic a joint as possible, a specific truss structure was selected on which to base the design. The structure considered was based on the 120 foot diameter aerobrake tetrahedral truss structure. The truss members were assumed to consist of graphite/epoxy tubes. Also, it was assumed that the nodes were constructed of 2219-T87 aluminum alloy. The magnitude of the member load assumed for design purposes was 100 kips. Author

N93-17327*# Chicago State Univ., IL. Dept. of Mathematics and Computer Science.

ELECTROMAGNETIC SCATTERING IN CLOUDS **c32**

Richard Solakiewicz *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

Techniques used to explain the nature of the optical effects of clouds on the light produced by lightning include a Monte Carlo simulation, an equivalent medium approach, and methods based on Boltzmann transport theory. A cuboidal cloud has been considered using transform methods and a diffusion approximation. Many simplifying assumptions have been used by authors to make this problem tractable. In this report, the cloud will have a spherical shape and its interior will consist of a uniform distribution of identical spherical water droplets. The source will be modeled as a Hertz dipole, electric or magnetic, inside or outside the cloud. An impulsive source is used. Superposition may be employed to obtain a sinusoid within an envelope which describes a lightning event. The problem is investigated by transforming to the frequency domain, obtaining Green's functions, and then using the Cagniard-DeHoop method to symbolically recover the time domain solution. Author

N93-17328*# University of Western Illinois, Macomb. Dept. of Mathematics.

RELIABILITY EVALUATION METHODOLOGY FOR NASA APPLICATIONS **c38**

Vidya S. Taneja *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

Liquid rocket engine technology has been characterized by the development of complex systems containing large number of subsystems, components, and parts. The trend to even larger and more complex system is continuing. The liquid rocket engineers have been focusing mainly on performance driven designs to increase payload delivery of a launch vehicle for a given mission. In otherwords, although the failure of a single inexpensive part or component may cause the failure of the system, reliability in general has not been considered as one of the system parameters like cost or performance. Up till now, quantification of reliability has not been a consideration during system design and development in the liquid rocket industry. Engineers and managers have long been aware of the fact that the reliability of the system increases during development, but no serious attempts have been made to quantify reliability. As a result, a method to quantify reliability during design and development is needed. This includes application of probabilistic models which utilize both engineering analysis and test data. Classical methods require the use of operating data for reliabiiity demonstration. In contrast, the method described in this paper is based on similarity, analysis, and testing combined with Bayesian statistical analysis. Author

N93-17329*# Kansas Univ., Lawrence. Dept. of Mechanical Engineering.

ACCELERATION OF FDNS FLOW SIMULATIONS USING INITIAL FLOWFIELDS GENERATED WITH A PARABOLIZED NAVIER-STOKES METHOD **c34**

Peter W. TenPas *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The capability of computational fluid dynamics (CFD) analysis to predict complex flowfields has been greatly advanced by the widespread use of flow simulation programs based on the Navier-Stokes (NS) equations. The flow physics are theoretically well represented, and with proper care the numerical solution should not introduce appreciable uncertainties. However, the computational cost of a typical simulation in terms of both memory and execution time are large by current standards. Therefore, the efficiency of the numerical algorithm in solving the set of model equations is one factor determining the usefulness of CFD tools. The objective of the present study is to reduce the execution time of the FDNS flow simulation code by using the parabolized Navier-Stokes (PNS) equations to provide a 'good' starting condition. The technique is not universal, however the PNS model can be applied to convection dominated flows with moderate deflection in geometries that are free of large obstructions. Author

N93-17330*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.

CONTROL-STRUCTURE-THERMAL INTERACTIONS IN ANALYSIS OF LUNAR TELESCOPES **c89**

Roger C. Thompson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The lunar telescope project was an excellent model for the CSTI study because a telescope is a very sensitive instrument, and thermal expansion or mechanical vibration of the mirror assemblies will rapidly degrade the resolution of the device. Consequently, the interactions are strongly coupled. The lunar surface experiences very large temperature variations that range from approximately -180 C to over 100 C. Although the optical assemblies of the telescopes will be well insulated, the temperature of the mirrors will inevitably fluctuate in a similar cycle, but of much smaller magnitude. In order to obtain images of high quality and clarity, allowable thermal deformations of any point on a mirror must be less than 1 micron. Initial estimates indicate that this corresponds to a temperature variation of much less than 1 deg through the thickness of the mirror. Therefore, a lunar telescope design will most probably include active thermal control, a means of controlling the shape of the mirrors, or a combination of both systems. Historically, the design of a complex vehicle was primarily a sequential process in which the basic structure was defined without concurrent detailed analyses or other subsystems. The basic configuration was then passed to the different teams responsible for each subsystem, and their task was to produce a workable solution without requiring major alterations to any principal components or subsystems. Consequently, the final design of the vehicle was not always the most efficient, owing to the fact that each subsystem design was partially

constrained by the previous work. This procedure was necessary at the time because the analysis process was extremely time-consuming and had to be started over with each significant alteration of the vehicle. With recent advances in the power and capacity of small computers, and the parallel development of powerful software in structural, thermal, and control system analysis, it is now possible to produce very detailed analyses of intermediate designs in a much shorter period of time. The subsystems can thus be designed concurrently, and alterations in the overall design can be quickly adopted into each analysis; the design becomes an iterative process in which it is much easier to experiment with new ideas, configurations, and components. Concurrent engineering has the potential to produce efficient, highly capable designs because the effect of one subystem on another can be assessed in much more detail at a very early point in the program. The research program consisted of several tasks: scale a prototype telescope assembly to a 1 m aperture, develop a model of the telescope assembly by using finite element (FEM) codes that are available on site, determine structural deflections of the mirror surfaces due to the temperature variations, develop a prototype control system to maintain the proper shape of the optical elements, and most important of all, demonstrate the concurrent engineering approach with this example. In addition, the software used for the finite element models and thermal analysis was relatively new within the Program Development Office and had yet to be applied to systems this large or complex; understanding the software and modifying it for use with this project was also required. The I-DEAS software by Structural Dynamics Research Corporation (SDRC) was used to build the finite element models, and TMG developed by Maya Heat Transfer Technologies, Ltd. (which runs as an I-DEAS module) was used for the thermal model calculations. All control system development was accomplished with MATRIX(sub X) by Integrated Systems, Inc.

Author

N93-17331*# Indiana Inst. of Tech., Fort Wayne. Dept. of Mechanical Engineering.

STIFFNESSES BY (TtN) ENSEMBLE MOLECULAR DYNAMICS c64

Patrick Tibbits *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

Calculation of elastic constants requires initializing a lattice of atoms, an h matrix defining the computational cell boundaries, and the parameters defining the interatomic potentials, then numerically integrating the equations of motion for the atoms and the computational cell boundaries, calculating strains and stresses at each timestep, and updating at each timestep the average quantities required for calculation of fluctuations. Enforcements of the DYNAMO FORTRAN code included addition of documentation, improved memory management and data flow, and enabling use of several interatomic potentials. Documentation included headers for each subroutine, which document the parameters input to the routine, algorithms employed, and output.

Author

N93-17332*# California Polytechnic State Univ., San Luis Obispo. Dept. of Materials Engineering.

UPT SCENARIOS: IMPLICATIONS FOR SYSTEM RELIABILITY c38

Daniel W. Walsh *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The objective of this project was to examine the corrosion resistance of 316L stainless steel in several urine pre-treat solutions. Four solutions were examined: untreated urine (control); urine pretreated with oxone (potassium peroxymonosulfate sulfate); urine pretreated with sodium hypochlorite (NaOCl); and urine pretreated with ozone (O3). In accordance with current procedures, all solutions but the control were acidified to a pH of 2.5 using sulfuric acid--this suppresses the generation of ammonia in the solutions and is intended to limit microbial growth. Welded and unwelded coupons were exposed to each solution. In addition, Titanium coupons (welded and unwelded) were exposed to biologically active environmental control and life support system (ECLSS) water. Microbial attachment and biofilm growth were monitored. Ozone was examined as a biocide/oxidizer/corrosion preventative (simultaneous addition) and as a remediation method (added one week after exposure). In an unrelated effort, HP 9-4-30 coupons were exposed to biologically active solutions. Corrosion rates for welded and unwelded samples were determined--results were correlated to the ongoing HP 9-4-30 weldment stress corrosion study.

Author

N93-17333*# Tuskegee Inst., AL. Dept. of Chemical Engineering.

THERMOSTRUCTURAL RESPONSES OF CARBON PHENOLICS IN A RESTRAINED THERMAL GROWTH TEST c27

C. Jeff Wang *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

The thermostructural response of carbon phenolic components in a solid rocket motor (SRM) is a complex process. It involves simultaneous heat and mass transfer along with chemical reactions in a multiphase system with time-dependent material properties and boundary conditions. In contrast to metals, the fracture of fiber-reinforced composites is characterized by the initiation and progression of multiple failures of different modes such as matrix cracks, interfacial debonding, fiber breaks, and delamination. The investigation of thermostructural responses of SRM carbon phenolics is further complicated by different failure modes under static and dynamic load applications. Historically, there have been several types of post-firing anomalies found in the carbon phenolic composites of the Space Shuttle SRM nozzle. Three major failure modes which have been observed on SRM nozzles are pocketing (spallation), ply-lift, and wedge-out. In order to efficiently control these anomalous phenomena, an investigation of fracture mechanisms under NASA/MSFC RSRM (Redesigned Solid Rocket Motor) and SPIP (Solid Propulsion Integrity Program) programs have been conducted following each anomaly. This report reviews the current progress in understanding the effects of the thermostructural behavior of carbon phenolics on the failure mechanisms of the SRM nozzle. A literature search was conducted and a technical bibliography was developed to support consolidation and assimilation of learning from the RSRM and SPIP investigation efforts. Another important objective of this report is to present a knowledge-based design basis for carbon phenolics that combines the analyses of thermochemical decomposition, pore pressure stresses, and thermostructural properties. Possible areas of application of the knowledge-based design include critical material properties development, nozzle component design, and SRM materials control.

Author

N93-17334*# Alabama A & M Univ., Huntsville. Dept. of Physics.

NATURE OF FLUID FLOWS IN DIFFERENTIALLY HEATED CYLINDRICAL CONTAINER FILLED WITH A STRATIFIED SOLUTION c34

Jai-Ching Wang *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)

Avail: CASI HC A01/MF A03

Semiconductor crystals such as Hg(1-x)Cd(x)Te grown by unidirectional solidification Bridgmann method have shown compositional segregations in both the axial and radial directions. Due to the wide separation between the liquidus and the solidus of its pseudobinary phase diagram, there is a diffusion layer of higher HgTe content built up in the melt near the melt-solid interface which gives a solute concentration gradient in the axial direction. Because of the higher thermal conductivity in the melt than that in the crystal there is a thermal leakage through the fused silica crucible wall near the melt-solid interface. This gives a thermal gradient in the radial direction. Hart (1971), Thorpe, Hutt and Soulsby (1969) have shown that under such condition a fluid will become convectively unstable as a result of different diffusivities of temperature and solute. It is quite important to understand the effects of this thermosolute convection on the compositional segregation in the unidirectionally solidified crystals. To reach this goal, we start with a simplified problem. We study the nature of fluid flows of a stratified solution in a cylindrical container with a radial temperature gradient. The cylindrical container wall is considered to be maintained at a higher temperature than that at the center of the solution and the solution in the lower gravitational direction has higher solute concentration which decrease linearly to a lower concentration and then remain constant to the top of the solution. The sample solution is taken to be salt water.

Author

N93-17335*# Alabama Univ., Birmingham. Dept. of Physics.

AN EXPERIMENT TO STUDY FULLERENE FORMATION UNDER REDUCED GRAVITY c29

Thomas J. Wdowiak *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

The activity of the summer focused on the design and construction of key components of a carbon arc/inert gas reactor for fullerene production, that is suitable for reduced gravity experiments onboard the KC-135 aircraft. The apparatus will be configured for both floor-mount and free-floating operation providing access to reduction to 10(exp -2) and 10(exp -3) of normal respectively. It is planned to incorporate 'seat belt' restraints that will allow a safe transition from reduced gravity free-float to full gravity, at the end of the parabolic. I.I.C.

N93-17336*# Alabama Univ., Tuscaloosa. Dept. of Aerospace Engineering.
NEURAL NETWORK ARCHITECTURES TO ANALYZE OPAD DATA c63
Kevin W. Whitaker *In its* 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

A prototype Optical Plume Anomaly Detection (OPAD) system is now installed on the space shuttle main engine (SSME) Technology Test Bed (TTB) at MSFC. The OPAD system requirements dictate the need for fast, efficient data processing techniques. To address this need of the OPAD system, a study was conducted into how artificial neural networks could be used to assist in the analysis of plume spectral data. I.I.C.

N93-17337*# Arkansas Univ., Fayetteville. Dept. of Mechanical Engineering.
COMPUTERIZED REDUCTION OF ELEMENTARY REACTION SETS FOR CFD COMBUSTION MODELING c25
Carl V. Wikstrom *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

Modeling of chemistry in Computational Fluid Dynamics can be the most time-consuming aspect of many applications. If the entire set of elementary reactions is to be solved, a set of stiff ordinary differential equations must be integrated. Some of the reactions take place at very high rates, requiring short time steps, while others take place more slowly and make little progress in the short time step integration. Author

N93-17338*# Alabama Univ., Huntsville. Dept. of Physics.
THE INNER MAGNETOSPHERIC IMAGER (IMI): INSTRUMENT HERITAGE AND ORBIT VIEWING ANALYSIS c35
Gordon R. Wilson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

For the last two years an engineering team in the Program Development Office at MSFC has been doing design studies for the proposed Inner Magnetospheric Imager (IMI) mission. This team had a need for more information about the instruments that this mission would carry so that they could get a better handle on instrument volume, mass, power, and telemetry needs as well as information to help assess the possible cost of such instruments and what technology development they would need. To get this information, an extensive literature search was conducted as well as interviews with several members of the IMI science working group. The results of this heritage survey are summarized below. There was also a need to evaluate the orbits proposed for this mission from the stand point of their suitability for viewing the various magnetospheric features that are planned for this mission. This was accomplished by first, identifying the factors which need to be considered in selecting an orbit, second, translating these considerations into specific criteria, and third, evaluating the proposed orbits against these criteria. The specifics of these criteria and the results of the orbit analysis are contained in the last section of this report. Author

N93-17339*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
ANALYSIS OF FILM COOLING IN ROCKET NOZZLES c20
Keith A. Woodbury *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

Computational Fluid Dynamics (CFD) programs are customarily used to compute details of a flow field, such as velocity fields or species concentrations. Generally they are not used to determine the resulting conditions at a solid boundary such as wall shear stress or heat flux. However, determination of this information should be within the capability of a CFD code, as the code supposedly contains appropriate models for these wall conditions. Before such predictions from CFD analyses can be accepted, the credibility of the CFD codes upon which they are based must be established. This report details the progress made in constructing a CFD model to predict the heat transfer to the wall in a film cooled rocket nozzle. Specifically, the objective of this work is to use the NASA code FDNS to predict the heat transfer which will occur during the upcoming hot-firing of the Pratt & Whitney 40K subscale nozzle (1Q93). Toward this end, an M = 3 wall jet is considered, and the resulting heat transfer to the wall is computed. The values are compared against experimental data available in Reference 1. Also, FDNS's ability to compute heat flux in a reacting flow will be determined by comparing the code's predictions against calorimeter data from the hot firing of a 40K combustor. The process of modeling the flow of combusting gases through the Pratt & Whitney 40K subscale combustor and nozzle is outlined. What follows in this report is a brief description of the FDNS code, with special emphasis on how it handles solid wall boundary conditions. The test cases and some FDNS solution are presented next, along with comparison to experimental data. The process of modeling the flow through a chamber and a nozzle using the FDNS code will also be outlined. Author

N93-17340*# Tuskegee Inst., AL. Dept. of Aerospace Science Engineering.
STRESS ANALYSIS AND DAMAGE EVALUATION OF FLAWED COMPOSITE LAMINATES BY HYBRID-NUMERICAL METHODS c24
Yii-Ching Yang *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

Structural components in flight vehicles is often inherited flaws, such as microcracks, voids, holes, and delamination. These defects will degrade structures the same as that due to damages in service, such as impact, corrosion, and erosion. It is very important to know how a structural component can be useful and survive after these flaws and damages. To understand the behavior and limitation of these structural components researchers usually do experimental tests or theoretical analyses on structures with simulated flaws. However, neither approach has been completely successful. As Durelli states that 'Seldom does one method give a complete solution, with the most efficiency'. Examples of this principle is seen in photomechanics which additional strain-gage testing can only average stresses at locations of high concentration. On the other hand, theoretical analyses including numerical analyses are implemented with simplified assumptions which may not reflect actual boundary conditions. Hybrid-Numerical methods which combine photomechanics and numerical analysis have been used to correct this inefficiency since 1950's. But its application is limited until 1970's when modern computer codes became available. In recent years, researchers have enhanced the data obtained from photoelasticity, laser speckle, holography and moire' interferometry for input of finite element analysis on metals. Nevertheless, there is only few of literature being done on composite laminates. Therefore, this research is dedicated to this highly anisotropic material. Author

N93-16861*# California Univ., San Diego, La Jolla. California Space Inst.
STRATEGIES FOR BROADENING PUBLIC INVOLVEMENT IN SPACE DEVELOPMENTS
Philip R. Harris et al *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 154-163 (For primary document see N93-16857 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N93-15680# General Accounting Office, Washington, DC. Resources Community and Economic Development Div.
FEDERAL RESEARCH: SMALL BUSINESS INNOVATION RESEARCH SHOWS SUCCESS BUT CAN BE STRENGTHENED
Mar. 1992 93 p
(AD-A256811; GAO/RCED-92-37) Avail: CASI HC A05/MF A01

The Federal Small Business Innovation Research (SBIR) program is examined. E.R.

N93-15806# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA.
THE EFFECTS OF PROCEDURAL STRUCTURE AND COMPUTER SUPPORT UPON SELECTING A TACTICAL COURSE OF ACTION Final Report, Feb. 1989 - Apr. 1992
Jon J. Fallesen, Charles F. Carter, Jr., Mike S. Perkins, Rex R. Michel, and James P. Flanagan Aug. 1992 143 p
(DA Proj. 2Q2-63007-A-793)
(AD-A257254; ARI-TR-960) Avail: CASI HC A07/MF A02

The U.S. Army wants its commanders and their staffs to consider a broad range of factors and to make tactical decisions quickly. The 'estimate of the situation' is a standard process for teaching tactical decision making. An experiment was conducted to compare structured procedures for the estimate to a condition where procedures were unspecified and to computer-supported procedures. The structured procedures were enforced through refresher training, written instructions, and manual job aids. In the unspecified condition, teams were explicitly instructed only to select a course of action (COA) and to justify their selection. Computer support was provided in the third condition by providing a prototype tactical data system with a spreadsheet tool for war gaming the COA's. The structured and computer-supported treatments led to significantly better justifications for COA selection than did the unspecified condition. Even though computer-supported teams had only about 2 hours of instruction, there was no difference in the quality of structured and computer-supported solutions. Most of the structured teams made arithmetic errors when comparing COA's; the computer-supported teams did not. Based on the results, future enhancements should be targeted at visualizing and understanding battle events and projecting battle outcomes. GRA

N93-15812# Yale Univ., New Haven, CT. Dept. of Computer Science.
KNOWLEDGE-BASED PLANNING Fiscal Year Report, 1 Oct. 1991 - 30 Sep. 1992
Drew McDermott and Gregory Hager 30 Sep. 1992 8 p
(Contract N00014-91-J-1577)
(AD-A257209) Avail: CASI HC A02/MF A01

The goal of our project is to study planning for autonomous agents with imperfect sensors in a dynamic world. Such agents must confront several problems: (1) how to synchronize plan execution with plan refinement; (2) how to generate reasonable plans quickly for complex goals, and improve them later; (3) how to trade off sensor-processing time against the quality of information; and (4) how to learn the structure of the environment as plan execution proceeds. GRA

N93-15895# Naval Postgraduate School, Monterey, CA.
INFORMATION ENGINEERING AND THE INFORMATION ENGINEERING FACILITY VERSUS RAPID APPLICATION DEVELOPMENT AND FOCUS M.S. Thesis
Lucille C. Clark Dec. 1992 231 p
(AD-A257297) Avail: CASI HC A11/MF A03

The Management Information Systems Department of the Naval Postgraduate School (NPS) is considering using the information engineering methodology with Texas Instrument's Information Engineering Facility (IEF), an integrated computer-aided software engineering toolset, for application development. The costs and benefits of introducing information engineering and IEF versus the rapid application development methodology and fourth generation programming language, FOCUS, were analyzed through a case study developed in both EEF and FOCUS. IEF offers a one model implementation, a standard computerized methodology, consistency checking, management tools for the application developer, and superior diagramming features and screen design whereas FOCUS offers rapid prototyping, numeric functions, a report facility, security within the data model, inherent database management facilities and excellent documentation. The benefits of IEF did not outweigh its costs. RAD and FOCUS were determined to be the methodology and tool of choice respectively for application development for the MIS department. GRA

N93-16373*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SPACE STATION FREEDOM TECHNOLOGY PAYLOAD USER OPERATIONS FACILITY CONCEPT
Gary N. Henning (Lockheed Engineering and Sciences Co., Hampton, VA.) and Don E. Avery Dec. 1992 14 p
(RTOP 506-49-31-03)
(NASA-TM-107701; NAS 1.15:107701) Avail: CASI HC A03/MF A01

This report presents a concept for a User Operations Facility (UOF) for payloads sponsored by the NASA Office of Aeronautics and Space Technology (OAST). The UOF can be located at any OAST sponsored center; however, for planning purposes, it is assumed that the center will be located at Langley Research Center (LaRC). Author

N93-16859*# California Univ., San Diego, La Jolla. California Space Inst.
THE FUTURE OF MANAGEMENT: THE NASA PARADIGM
Philip R. Harris *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 120-142 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

N93-16868*# California Univ., San Diego, La Jolla. California Space Inst.
SUMMER STUDY POSTSCRIPT: A 1986 PERSPECTIVE
Philip R. Harris et al *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 295-299 (For primary document see N93-16857 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

N93-17281*# Alabama Univ., Huntsville. Dept. of Industrial Engineering.
SYSTEMS ENGINEERING PROCESS AND ORGANIZATION ASSESSMENT
Robert G. Batson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 4 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17293*# Alabama Univ., Huntsville. Dept. of Industrial and Systems Engineering.
EVALUATION AND RECOMMENDATIONS FOR WORK GROUP INTEGRATION WITHIN THE MATERIALS AND PROCESSES LAB
Phillip A. Farrington *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 6 p (For primary document see N93-17279 05-80)
Avail: CASI HC A02/MF A03

N93-17301*# Alabama Univ., Huntsville. Dept. of Management and Marketing.
SOME EFFECTS OF TIME USAGE PATTERNS ON THE PRODUCTIVITY OF ENGINEERS
Conrad N. Jackson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N93-15808# Lawrence Livermore National Lab., CA.
INTERFACING 1990 US CENSUS TIGER MAP FILES WITH New S GRAPHICS SOFTWARE
M. Rizzardi, M. S. Mohr, D. W. Merrill, and S. Selvin Jul. 1992 21 p
(Contract DE-AC03-76SF-00098)
(DE93-001518; LBL-32641) Avail: CASI HC A03/MF A01

In 1990, the United States Bureau of the Census released detailed geographic base files known as TIGER/Line (Topologically Integrated Geographic Encoding and Referencing) which contain detail on the physical features and census tract boundaries of every county in the United States. The TIGER database is attractive for two reasons. First, it is publicly available through the Bureau of the Census on tape or cd-rom for a minimal fee. Second, it contains 24 billion characters of data which describe geographic features of interest to the Census Bureau such as coastlines, hydrography, transportation networks, political boundaries, etc. Unfortunately, the large TIGER database only provides raw alphanumeric data; no utility software, graphical or otherwise, is included. On the other hand New S, a popular statistical software package by AT&T, has easily operated functions that permit advanced graphics in conjunction with data analysis. New S has the ability to plot contours, lines, segments, and points. However, of special interest is the New S function map and its options. Using the map function, which requires polygons as input, census tracts can be quickly selected, plotted, and shaded. New S graphics combined with the TIGER database has obvious potential. This paper reports on our efforts to use the TIGER map files with New S, especially to construct census tract maps of counties. While census tract boundaries are inherently polygonal, they are not organized as such in the TIGER database. This conversion of the TIGER 'line' format into New S 'polygon/polyline' format is one facet of the work reported here. Also we discuss the selection and extraction of auxiliary geographic information from TIGER files for graphical display using New S. DOE

N93-15868# Naval Postgraduate School, Monterey, CA.
AN INVESTIGATION OF REQUIREMENTS TRACEABILITY TO SUPPORT SYSTEMS DEVELOPMENT M.S. Thesis
Ann G. Abbott and Mona R. Busch Sep. 1992 62 p
(AD-A257444) Avail: CASI HC A04/MF A01

A primary concern in the development of large scale, real time, complex, computer intensive systems is ensuring that the system meets the specified requirement. Further, the requirements themselves evolve and undergo many changes during the development process. In such a context, it is essential to maintain traceability of requirements to various outputs to ensure that the systems meets the current set of requirements. An empirical study, utilizing focus group and protocol analysis techniques, was conducted with students from the Naval Postgraduate School. Their input, along with current literature, was used to explore factors to be taken into account while developing a model of traceability, and the appropriateness of the two data collection methods in future research. GRA

N93-15870# Naval Postgraduate School, Monterey, CA.
A FRAMEWORK FOR CLASSIFYING AND RESOLVING SEMANTIC CONFLICTS USING THE ENHANCED ENTITY-RELATIONSHIP MODEL M.S. Thesis
Daniel A. Lindsey Sep. 1992 137 p
(AD-A257452) Avail: CASI HC A07/MF A02

In today's organizations, information in current databases is stored in a variety of heterogeneous systems and data organizations. This situation causes problems when trying to integrate them into a federated or multidatabase solution. Particularly troublesome is semantic conflict, or differences in the meanings of data structures and definitions in heterogeneous databases. This thesis proposes a systematic approach towards identifying, classifying and resolving semantic conflicts. Using an entity relationship approach as the integrating model, a framework is developed which describes all possible semantic conflicts among the underlying schemas. This framework can be employed as a methodological tool during an integration effort. Possible resolution strategies are offered for each type of conflict and applied to the separate databases to realize a common global schema which could be used to formulate effective queries against the total original volume of data. GRA

N93-15886# Texas Univ., Austin. Dept. of Computer Sciences.
EXTRACTING VIEWPOINTS FROM MULTIFUNCTIONAL KNOWLEDGE BASES Final Report, Feb. - Dec. 1991
Liane Acker and Bruce Porter Sep. 1992 17 p
(Contract F33615-90-C-0014)
(AD-A256008; AL-TR-1992-0091) Avail: CASI HC A03/MF A01

Viewpoints are coherent collections of facts that describe a concept from a particular perspective. They are essential for a wide variety of tasks, such as explanation generation and qualitative modeling. We have identified many types of viewpoints and developed a program, the View Retriever, for extracting them from knowledge bases, either singly or in combinations. The View Retriever provides a general solution to the central problem in extracting viewpoints: determining which facts are relevant to requested viewpoints. Our evaluation of the View Retriever indicates that it provides most of the types of viewpoints that people use, and its viewpoints are comparable in coherence to those constructed by people. GRA

N93-15953# New Energy and Industrial Technology Development Organization, Tokyo (Japan).
PREPARATION OF THE PACIFIC REGION ENERGY INFORMATION EXCHANGE SYSTEM
Mar. 1992 302 p
(DE93-716353; NEDO-P-9174) Avail: CASI HC A14/MF A03

For the purpose of expanding the basis for collecting information concerning the energy situation in the pacific countries, the paper reports investigations that were made since 1989 by the Institute of Energy Economics contracting with NEDO. In FY-91 the development of a full-scale network was made necessary by participating in the energy supply/demand project of the Asia-Pacific Economic Cooperation Conference (APEC) and by collecting energy data from each participating nation and compiling statistics. As a result of the trial, it turns out that there are a lot of demands on the time limit of data submission: the format (pigeonholing of the items in every country, different energy sources peculiar to the country); unit standardization, etc. Furthermore, there are future subjects such as quality improvement and quantity increase of the data, that necessitate the development of a computer network. DOE

N93-15993# Naval Postgraduate School, Monterey, CA.
A RELATIONAL/OBJECT-ORIENTED DATABASE MANAGEMENT SYSTEM: R/OODBMS M.S. Thesis
Ronald L. Spear Sep. 1992 225 p
(AD-A257339) Avail: CASI HC A10/MF A03

During the last decade, the business sector has become increasingly reliant upon information management. This trend will most likely continue. Deficiencies/constraints in conventional database management systems continue to become more apparent as this reliance continues to grow. Primary areas of deficiency are in modeling, storing, and managing increasingly complex information as in CAD and CASE among others. The purpose of this thesis is to implement a combined relational/object-oriented database management system that will overcome these deficiencies and/or constraints. Three possible approaches to such a system exist: build the system from scratch, build object-oriented capabilities on top of an existing relational system, or build relational capabilities on top of an existing object-oriented system. The last approach is the one chosen for this work. This thesis expands previous work in this area and uses a commercial object-oriented database management system, IDB, in its implementation. GRA

N93-15995# Naval Postgraduate School, Monterey, CA.
ON INCREASING THE EFFECTIVE BLOCKING FACTOR OF A MATRIX FOR A GIVEN CACHE ORGANIZATION M.S. Thesis
Atilla N. Demirhan Sep. 1992 72 p
(AD-A257342) Avail: CASI HC A04/MF A01

Blocking (Tiling) techniques of iteration spaces to increase data reuse in the cache were reviewed. Results consistent with those previously

published were experimentally obtained. The relation between the sizes of the declared matrix and the cache was studied. Based on this relation, two algorithms were presented. Both algorithms attempt to increase the critical blocking factor with no self-interference (Bc) by changing the declared matrix size. Furthermore, the execution time of the second algorithm is independent of the matrix size. Experiments based on these algorithms were performed which showed a consistent superior performance (in terms of Mflops) relative to the performance obtained using previously published algorithms for deriving Bc. GRA

N93-16021# Energy Technology Data Exchange, Oak Ridge, TN.
INTERNATIONAL ENERGY SUBJECT CATEGORIES AND SCOPE
R. Rutkowski, ed. and L. Kane, ed. 1992 64 p
(DE92-018520; ETDE/Pub-1-R2) Avail: CASI HC A04/MF A01

The purpose of this publication is twofold: (1) to support organizations or individuals who select informational materials for inclusion in the ETDE Energy Data Base; and (2) for use as an aid in database searching. Subject categories and corresponding codes are established to define the scope of, or degree of interest in, energy information to be selected by those who enter machine-readable bibliographic records into the Energy Data Base. For persons conducting online searching or creating selective dissemination of information (SDI) subsets, this publication facilitates the selection of energy topics. These scope notes and category definitions also apply to online energy databases identified as ENERGY on STN International (Federal Republic of Germany) and as ENERGY SCIENCE & TECHNOLOGY offered by DIALOG Information Services, Inc. (USA). The subject scope of the database encompasses all technological aspects of energy production, conversion, and efficient utilization, as well as related economic, social, and political aspects. Major topical areas are fossil fuels, renewable energy sources, nuclear energy, fusion energy, energy storage and conversion, end-use technology, advanced energy systems, and energy policy. Coverage also includes aspects of chemistry, engineering, environmental science, biomedical science, physics, mathematics, computer science, materials, and instrumentation related to energy technology. Subject categories are used to define broad subject areas in the field of energy, and can also provide a powerful tool in both increasing the relevancy of retrieval and simplifying the search strategy needed to retrieve a specific concept. DOE

N93-16063# Defense Technical Information Center, Alexandria, VA.
SOURCE HEADER LIST. VOLUME 1: A THROUGH J Report, Sep. 1990 - Sep. 1992
Loretta Brown Sep. 1992 588 p Supersedes DTIC/TR-90/3-Vol-1, AD-A231000
(AD-A256000; DTIC/TR-92/5-Vol-1; DTIC/TR-90/3-Vol-1) Avail: CASI HC A25/MF A06

This publication is the first of two volumes of an alphabetically arranged, compilation of corporate author names used by the Defense Technical Information Center in the DTIC database system. Each source name is assigned a 6-digit numeric code for computer input and retrieval purposes plus a 4-digit alphanumeric geopolitical code and an alphanumeric type code. Source names displayed are included as data elements in the Technical Report, Work Unit Information System and Independent Research and Development databases maintained by DTIC. GRA

N93-16064# Defense Technical Information Center, Alexandria, VA.
SOURCE HIERARCHY LIST. VOLUME 2: E THROUGH N Report, Sep. 1990 - Oct. 1992
Claudine S. Long Oct. 1992 848 p Supersedes DTIC/TR-90/4-Vol-2, AD-A231101
(AD-A256101; DTIC/TR-92/6-Vol-2; DTIC/TR-90/4-Vol-2) Avail: CASI HC A99/MF A10

This is the second of three volumes of an alphabetical listing of corporate authors as used for announcement of reports received in the Defense Technical Information Center (DTIC). Former names of organizations are included and displayed below the current source name used by DTIC. Cross references direct the user from sub-element organizations to the major source level entry where they are also displayed. Major and sub-hierarchies are preceded and ended by a row of asterisks. This list is used in conjunction with and is not a replacement for DTIC's Source Header List, Volume 1, AD-A256000, and Volume 2, AD-A256001. It displays only those source names from the Source Header List which hierarchical linkages are pertinent. GRA

N93-16065# Defense Technical Information Center, Alexandria, VA.
SOURCE HIERARCHY LIST. VOLUME 3: O THROUGH Z Report, Sep. 1990 - Oct. 1992
Claudine S. Long Oct. 1992 762 p Supersedes DTIC/TR-90/4-Vol-3, AD-A231102
(AD-A256102; DTIC/TR-92/6-Vol-3; DTIC/TR-90/4-Vol-3) Avail: CASI HC A99/MF A06

This is the third of three volumes of an alphabetical listing of corporate authors as used for announcement of reports received in the Defense Technical Information Center (DTIC). Former names of organizations are included and displayed below the current source name used by DTIC. Cross references direct the user from sub-element organizations to the major source level entry where they are also displayed. Major and sub-hierarchies are preceded and ended by a row of asterisks. This list is used in conjunction with and is not a replacement for DTIC's Source Header List, Volume 1, AD-A256000, and Volume 2, AD-A256001. It displays only those source names from the Source Header List which hierarchical linkages are pertinent. GRA

N93-16115# Naval Postgraduate School, Monterey, CA.
DEVELOPMENT OF A FACULTY RESEARCH AND PUBLICATION DATABASE SYSTEM M.S. Thesis
Brian E. Tansey Jul. 1992 109 p
(AD-A257107) Avail: CASI HC A06/MF A02

The Administrative Sciences (AS) Department of the Naval Postgraduate School (NPS) maintains a substantial amount of faculty research and publication data that is used to support its vast and varied informational needs. The data consists of all departmental publications that have been written by Administrative Science faculty members. This database requires constant maintenance to ensure accurate, up-to-date publication information that can be rapidly accessed at anytime. This thesis will define, design and implement a database application that the Administrative Sciences Department can use to systematically manage their faculty publication database for automatic retrieval and reporting. This new prototype software is named 'Faculty Research and Publication Database System (FPDS)', version 1.0. This thesis provides an in depth outline covering software requirements analysis, design and implementation. The system was written using dBase 4, version 1.1. GRA

N93-16116# Naval Postgraduate School, Monterey, CA.
ANALYSIS, DESIGN, AND IMPLEMENTATION OF A DATABASE MANAGEMENT SYSTEM FOR THE NAVAL POSTGRADUATE SCHOOL ALUMNI ASSOCIATION M.S. Thesis
Mark T. Kohlheim Sep. 1992 75 p
(AD-A257109) Avail: CASI HC A04/MF A01

The Naval Postgraduate School Alumni Association is a professional group consisting of graduates from the Postgraduate School. The Alumni Association is a self supporting entity that is not part of the administrative structure of the school. The Alumni Association supports itself through membership fees paid by graduates who join the association. The administrative work required to run the association is accomplished through a part-time employee and volunteers. Until recently, the Alumni Association was unorganized and lacked a firm plan of action to establish itself with the School's graduates and to increase its membership base. Records of graduates were located in various locations and in different formats which made tracking and contacting alumni an extremely time consuming operation. This thesis develops a database management system for the Naval Postgraduate School Alumni Association. This system provides a standardized format for storing data and tracking alumni. It also performs the time consuming accounting and billing functions associated with the Association's membership management. This thesis provides an outline covering the Alumni Association's system requirements analysis and design methodology. The system was written using dBASE IV, version 1.1. GRA

N93-16151# Department of Energy, Oak Ridge, TN. Office of Scientific and Technical Information.
INFOTECH 1992: DOE TECHNICAL INFORMATION (TI) MEETING
J. M. Blanton 1992 186 p Presented at the Infotech 1992, Oak

Ridge, TN, 21-23 Oct. 1992
(DE93-000467; CONF-9210158) Avail: CASI HC A09/MF A02

Papers presented at the 1992 Department of Energy (DOE) Technical Information Meeting held at the Office of Scientific and Technical Information (OSTI), Oak Ridge, Tennessee, October 21-23, 1992 are included. It is composed of written presentations given orally at the meeting in either large-group or break-out sessions. The proceedings is provided as a reference tool for those who attended the meeting as well as an information document for those unable to attend. The annual DOE Technical Information meeting is designed for information professionals involved in the management of the Department's scientific and technical information (STI). Speakers include members of the OSTI staff as well as DOE and DOE contractors and other invited specialists in the field of information. The major objective of the meeting is to provide a forum within the Department for discussing current and future information policies, trends, and management techniques as well as the technologies and standards available for managing and accessing scientific and technical information. DOE

N93-16233*# National Aeronautics and Space Administration, Washington, DC.

THE AEROSPACE DATABASE DATA ELEMENT DICTIONARY WITH ISSUES AND RECOMMENDATIONS FROM THE MEETINGS OF JULY 24-25, AUGUST 13-14, AND SEPTEMBER 24-25, 1991

Dec. 1991 143 p
(NASA-TM-108156; NAS 1.15:108156) Avail: CASI HC A07/MF A02

The present volume contains descriptions of the individual fields (data elements) which comprise the bibliographic records of the Aerospace Database. Indexes by field name and field mnemonic are provided. In addition, the issues and recommendations defined by the NASA STI Database Upgrade Working Group are included as annotations to the individual field descriptions and are listed at the end of the volume. The activities of the Working Group were initiated by the NASA STI Program Coordinating Council as part of an effort to improve overall database quality. Author

N93-16259# Assistant Secretary of Defense (Communications Command Control and Intelligence), Washington, DC.

DEPARTMENT OF DEFENSE DIRECTIVE (DODD) 8000.1 DEFENSE INFORMATION MANAGEMENT (IM) PROGRAM Final Report

27 Oct. 1992 11 p
(AD-A256988) Avail: CASI HC A03/MF A01

DoDD 8000.1 implements the information management program for the Department of Defense, in according with responsibilities assigned the Directive for the Assistant Secretary of Defense for Command, Control, Communications and Intelligence. DoDD 8000.1 incorporate policies and responsibilities from SECDEF memorandum and the Corporate Information Management Implementation Plan. GRA

N93-16320*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

NSSDC CONFERENCE ON MASS STORAGE SYSTEMS AND TECHNOLOGIES FOR SPACE AND EARTH SCIENCE APPLICATIONS, VOLUME 2

Ben Kobler, ed., P. C. Hariharan, ed. (ST Systems Corp., Lanham, MD.), and L. G. Blasso, ed. (ST Systems Corp., Lanham, MD.) Washington Sep. 1992 257 p Conference held in Greenbelt, MD, 23-25 Jul. 1991
(RTOP 656-80-02-26)
(NASA-CP-3165-Vol-2; Rept-92B00093-Vol-2; NAS 1.55:3165-Vol-2) Avail: CASI HC A12/MF A03

This report contains copies of nearly all of the technical papers and viewgraphs presented at the NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Application. This conference served as a broad forum for the discussion of a number of important issues in the field of mass storage systems. Topics include the following: magnetic disk and tape technologies; optical disk and tape; software storage and file management systems; and experiences with the use of a large, distributed storage system. The technical presentations describe, among other things, integrated mass storage systems that are expected to be available commercially. Also included is a series of presentations from Federal Government organizations and research institutions covering their mass storage requirements for the 1990's. For individual titles, see N93-16321 through N93-16333.

N93-16321*# Shell Development Co., Houston, TX.

STEWARDSHIP OF VERY LARGE DIGITAL DATA ARCHIVES

Patric Savage *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 5 p(SEE N93-16320 05-82) Sep. 1992 (For primary document see N93-16320 05-82)
Avail: CASI HC A01/MF A03

This paper addresses the problems foreseen by the author in stewarding the very large digital data archives that will accumulate during the mission of the Earth Orbiting Satellite (EOS). It focuses on the function of 'shepherding' archived digital data into an endless future. Stewardship entails a great deal more than storing and protecting the archive. It also includes all aspects of providing meaningful service to the community of users (scientists) who will want to access the data. The complete steward will be required to do the following: (1) provide against loss due to physical phenomena; (2) assure that data is not 'lost' due to storage technology obsolescence; (3) maintain data in a current formatting methodology with the additional requirement of being able to reconstitute the data to its original, as-received format; (4) secure against loss or pollution of data due to accidental, misguided, or willful software intrusion; (5) prevent unauthorized electronic access to the data, including unauthorized placement of data into the archive; (6) index the data in a metadatabase so that all anticipatable queries can be served without searching through the data itself; (7) provide responsive access to the metadatabase; (8) provide appropriately responsive access to the data; (9) incorporate additions and changes to the archive (and to the metadatabase) in a timely way; and (10) deliver only copies of data to clients - retain physical custody of the 'official' data. Items 1 through 4 are discussed in this paper. Author

N93-16322*# APTEC Computer Systems, Portland, OR.

AN OPEN, PARALLEL I/O COMPUTER AS THE PLATFORM FOR HIGH-PERFORMANCE, HIGH-CAPACITY MASS STORAGE SYSTEMS

Adrian Abineri and Y. P. Chen *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 Sep. 1992 10 p (For primary document see N93-16320 05-82)
Avail: CASI HC A02/MF A03

APTEC Computer Systems is a Portland, Oregon based manufacturer of I/O computers. APTEC's work in the context of high density storage media is on programs requiring real-time data capture with low latency processing and storage requirements. An example of APTEC's work in this area is the Loral/Space Telescope-Data Archival and Distribution System. This is an existing Loral AeroSys designed system, which utilizes an APTEC I/O computer. The key attributes of a system architecture that is suitable for this environment are as follows: (1) data acquisition alternatives; (2) a wide range of supported mass storage devices; (3) data processing options; (4) data availability through standard network connections; and (5) an overall system architecture (hardware and software designed for high bandwidth and low latency). APTEC's approach is outlined in this document. D.R.D.

N93-16323*# E-Systems, Inc., Dallas, TX. Garland Div.

EMASS (TM): AN EXPANDABLE SOLUTION FOR NASA SPACE DATA STORAGE NEEDS

Anthony L. Peterson and P. Larry Cardwell *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 Sep. 1992 14 p (For primary document see N93-16320 05-82)
Avail: CASI HC A03/MF A03

The data acquisition, distribution, processing, and archiving requirements of NASA and other U.S. Government data centers present significant data management challenges that must be met in the 1990's. The Earth Observing System (EOS) project alone is expected to generate daily data volumes greater than 2 Terabytes (2(10)(exp 12) Bytes). As the scientific community makes use of this data their work product will result in larger, increasingly complex data sets to be further exploited and managed. The challenge for data storage systems is to satisfy the initial data management requirements with cost effective solutions that provide for planned growth. This paper describes the expandable architecture of the E-Systems Modular Automated Storage System (EMASS (TM)), a mass storage system which is designed to support NASA's data capture, storage, distribution, and management requirements into the 21st century. Author

N93-16324*# Mitre Corp., Bedford, MA.
DATA STORAGE AND RETRIEVAL SYSTEM
Glen Nakamoto *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 Sep. 1992 18 p Previously announced as N93-15036 (For primary document see N93-16320 05-82)
Avail: CASI HC A03/MF A03

The Data Storage and Retrieval System (DSRS) consists of off-the-shelf system components integrated as a file server supporting very large files. These files are on the order of one gigabyte of data per file, although smaller files on the order of one megabyte can be accommodated as well. For instance, one gigabyte of data occupies approximately six 9-track tape reels (recorded at 6250 bpi). Due to this large volume of media, it was desirable to 'shrink' the size of the proposed media to a single portable cassette. In addition to large size, a key requirement was that the data needs to be transferred to a (VME based) workstation at very high data rates. One gigabyte (GB) of data needed to be transferred from an archiveable media on a file server to a workstation in less than 5 minutes. Equivalent size, on-line data needed to be transferred in less than 3 minutes. These requirements imply effective transfer rates on the order of four to eight megabytes per second (4-8 MB/s). The DSRS also needed to be able to send and receive data from a variety of other sources accessible from an Ethernet local area network. Author

N93-16325*# Mesa Archival Systems, Inc., Boulder, CO.
THE CHALLENGE OF A DATA STORAGE HIERARCHY
Michael Ruderman *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 Sep. 1992 29 p (For primary document see N93-16320 05-82)
Avail: CASI HC A03/MF A03

A discussion of Mesa Archival Systems' data archiving system is presented. This data archiving system is strictly a software system that is implemented on a mainframe and manages the data into permanent file storage. Emphasis is placed on the fact that any kind of client system on the network can be connected through the Unix interface of the data archiving system. D.R.D.

N93-16326*# Metrum Information Storage, Hunt Valley, MD.
NETWORK ACCESSIBLE MULTI-TERABYTE ARCHIVE
Fred Rybczynski *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 Sep. 1992 13 p (For primary document see N93-16320 05-82)
Avail: CASI HC A03/MF A03

Features of the Rotary Storage System (RSS), developed by Metrum Information Storage, are presented in vugraph format. The RSS makes use of the T-120 Super-VHS media with 10.4 GB per cartridge. Other features of the RSS are as follows: (1) Very Large Data Store (VLDS) tape drives; (2) robots with on-line capacity to 6.2 TB; (3) bar code reader; (4) data management computer; and (5) network accessible. D.R.D.

N93-16327*# Imperial Chemical Industries Ltd., Runcorn (England). Imagedata Div.
ICI OPTICAL DATA STORAGE TAPE
Robert A. McLean and Joseph F. Duffy *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 Sep. 1992 12 p (For primary document see N93-16320 05-82)
Avail: CASI HC A03/MF A03

Optical data storage tape is now a commercial reality. The world's first successful development of a digital optical tape system is complete. This is based on the Creo 1003 optical tape recorder with ICI 1012 write-once optical tape media. Flexible optical media offers many benefits in terms of manufacture; for a given capital investment, continuous, web-coating techniques produce more square meters of media than batch coating. The coated layers consist of a backcoat on the non-active side; on the active side there is a subbing layer, then reflector, dye/polymer, and transparent protective overcoat. All these layers have been tailored for ease of manufacture and specific functional characteristics. Author

N93-16328*# Odetics, Inc., Anaheim, CA. ATL Products Div.
ATL PRODUCTS DIVISION'S ENTRIES INTO THE COMPUTER MASS STORAGE MARKETPLACE
Fred Zeiler *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 Sep. 1992 12 p (For primary document see N93-16320 05-82)
Avail: CASI HC A03/MF A03

A review of Odetics' offerings to the mass storage market is given. The main topic of this article is a discussion of Odetics' robotic libraries. The presentation was given in vugraph format. Author

N93-16329*# Sony Magnetic Products, Inc., Miyagi (Japan).
STABILITY OF METAL PARTICLE AND METAL PARTICULATE MEDIA **c35**
Kazuhiro Okamoto *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 6 p(SEE N93-16320 05-82) Sep. 1992 (For primary document see N93-16320 05-82)
Avail: CASI HC A02/MF A03

Metal particulate (MP) video tape was launched for 8 mm video tape in 1985. Since then MP tapes have been applied to several consumer formats and instrumental formats because of its superior electrical performance. Recently data storage media, such as DDS and D-8, have started employing MP tape. However, there are serious concerns with archival stability of MP tape particularly in the case of data storage use, as metal particles essentially have problems with chemical instability and are susceptible to oxidation and corrosion. Although there were some studies about the archival stability of metal particles or MP tapes, a clear understanding has yet to be reached. In this paper, we report the stability of magnetic properties of current metal particles, and then discuss the new technologies to improve the stability further. Author

N93-16330*# Ampex Corp., Redwood City, CA.
AN EMPIRICAL APPROACH TO PREDICTING LONG TERM BEHAVIOR OF METAL PARTICLE BASED RECORDING MEDIA **c35**
Allan S. Hadad *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 Sep. 1992 17 p Previously announced as N93-15043 (For primary document see N93-16320 05-82)
Avail: CASI HC A03/MF A03

Alpha iron particles used for magnetic recording are prepared through a series of dehydration and reduction steps of alpha-Fe2O3-H2O resulting in acicular, polycrystalline, body centered cubic (bcc) alpha-Fe particles that are single magnetic domains. Since fine iron particles are pyrophoric by nature, stabilization processes had to be developed in order for iron particles to be considered as a viable recording medium for long term archival (i.e., 25+ years) information storage. The primary means of establishing stability is through passivation or controlled oxidation of the iron particle's surface. A study was undertaken to examine the degradation in magnetic properties as a function of both temperature and humidity on silicon-containing iron particles between 50-120 C and 3-89 percent relative humidity. The methodology to which experimental data was collected and analyzed leading to predictive capability is discussed. Author

N93-16331*# Ampex Corp., Redwood City, CA.
THE 19 mm DATA RECORDERS SIMILARITIES AND DIFFERENCES **c35**
Steve Atkinson *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 5 p(SEE N93-16320 05-82) Sep. 1992 Previously announced as N93-15042 (For primary document see N93-16320 05-82)
Avail: CASI HC A01/MF A03

Confusion over the use of non-video 19 mm data recorders is becoming more pronounced as we enter the world of high performance computing. This paper addresses the following: the differences between ID-1, ID-2, MIL-STD-2179 and DD-2; what the proper machine is for various applications; how the machine can be integrated into an environment; and any misconceptions there might be about 19 mm tape recorders. DD-2 and 19 mm instrumentation recorders have missions for which each is well designed.

While the differences may appear subtle, understanding the difference between the two is the key to picking the right recorder for a particular application. D.R.D.

N93-16332*# STX Corp., Hampton, VA.
DATA STORAGE AND RETRIEVAL SYSTEM ABSTRACT **c35**
Barbara Matheson *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 6 p(SEE N93-16320 05-82) Sep. 1992 (For primary document see N93-16320 05-82)
Avail: CASI HC A02/MF A03

The STX mass storage system design is intended for environments requiring high speed access to large volumes of data (terabyte and greater). Prior to commitment to a product design plan, STX conducted an exhaustive study of the commercially available off-the-shelf hardware and software. STX also conducted research into the area of emerging technologies in networks and storage media so that the design could easily accommodate new interfaces and peripherals as they came on the market. All the selected system elements were brought together in a demo suite sponsored jointly by STX and ALLIANT where the system elements were evaluated based on actual operation using a client-server mirror image configuration. Testing was conducted to assess the various component overheads and results were compared against vendor data claims. The resultant system, while adequate to meet our capacity requirements, fell short of transfer speed expectations. A product team lead by STX was assembled and chartered with solving the bottleneck issues. Optimization efforts yielded a 60 percent improvement in throughput performance. The ALLIANT computer platform provided the I/O flexibility needed to accommodate a multitude of peripheral interfaces including the following: up to twelve 25MB/s VME I/O channels; up to five HiPPI I/O full duplex channels; IPI-s, SCSI, SMD, and RAID disk array support; standard networking software support for TCP/IP, NFS, and FTP; open architecture based on standard RISC processors; and V.4/POSIX-based operating system (Concentrix). All components including the software are modular in design and can be reconfigured as needs and system uses change. Users can begin with a small system and add modules as needed in the field. Most add-ons can be accomplished seamlessly without revision, recompilation or re-linking of software. Author

N93-16333*# CONVEX Computer Corp., Richardson, TX.
OPEN SYSTEMS STORAGE PLATFORMS
Kirby Collins *In* NASA. Goddard Space Flight Center, NSSDC Conference on Mass Storage Systems and Technologies for Space and Earth Science Applications, Volume 2 Sep. 1992 10 p (For primary document see N93-16320 05-82)
Avail: CASI HC A02/MF A03

The building blocks for an open storage system includes a system platform, a selection of storage devices and interfaces, system software, and storage applications CONVEX storage systems are based on the DS Series Data Server systems. These systems are a variant of the C3200 supercomputer with expanded I/O capabilities. These systems support a variety of medium and high speed interfaces to networks and peripherals. System software is provided in the form of ConvexOS, a POSIX compliant derivative of 4.3BSD UNIX. Storage applications include products such as UNITREE and EMASS. With the DS Series of storage systems, Convex has developed a set of products which provide open system solutions for storage management applications. The systems are highly modular, assembled from off the shelf components with industry standard interfaces. The C Series system architecture provides a stable base, with the performance and reliability of a general purpose platform. This combination of a proven system architecture with a variety of choices in peripherals and application software allows wide flexibility in configurations, and delivers the benefits of open systems to the mass storage world. Author

N93-16370# Nijmegen Univ. (Netherlands). Dept. of Informatics.
STRATIFIED HYPERMEDIA STRUCTURES FOR INFORMATION DISCLOSURE
P. D. Bruza and T. P. vanderWeide 3 Dec. 1991 34 p Sponsored in part by Commission of the European Communities
(TR-91-27; ETN-93-92811) Avail: CASI HC A03/MF A01

The two level approach to hypertext (hypermedia) systems into stratified hypermedia structures is generalized. The overall architecture of such systems, including the fundamentals of the user interface, is described. Special emphasis is paid to the layering of the underlying information model. Two layers are featured: the hyperbase and the hyperindex. A characterization calculus is presented for the characterization of structured elements. This calculus is useful for quality assurance in hypermedia applications. In addition, this calculus forms the basis of a logic based approach in connection with the associated information processor (Disclosure Machine). Attention is also paid to spatial coherence for relevance judgements. ESA

N93-16371# Nijmegen Univ. (Netherlands). Dept. of Informatics.
DATA MODELLING IN COMPLEX APPLICATION DOMAINS
A. H. M. terHofstede, H. A. Proper, and T. P. vanderWeide Jan. 1992 9 p Sponsored by Software Engineering Research Centre and Netherlands Organization for Applied Scientific Research
(TR-92-01; ETN-93-92812) Avail: CASI HC A02/MF A01

A general data modeling technique is introduced. In many non trivial application domains, object types with a complex structure occur. Data modeling techniques which only allow flat structures are not suitable for representing such complex object types. A general data modeling technique, the Predicator Set Model (PSM), is introduced, which is capable of representing complex structures in a natural way. The expressiveness of the PSM is illustrated by means of a number of examples. In those examples, the PSM expressiveness is related to the expresiveness of more traditional modeling techniques. Some notational conventions are defined, which enable a more compact representation of complex structures. ESA

N93-16563# Manchester Univ. (England). Aeronautical Engineering Group.
AERONAUTICAL ENGINEERING GROUP PUBLICATIONS: 1950 - PRESENT
1991 30 p
(Aero-Rept-9108; ETN-92-92775) Avail: CASI HC A03/MF A01

The full title, name of author(s), and name of publication in which papers concerned with aeronautical engineering are found, are listed. Publications date from 1950 to present day. Not all of the reports are available for general distribution. ESA

N93-16707*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
UTILIZING SEMANTIC NETWORKS TO DATABASE AND RETRIEVE GENERALIZED STOCHASTIC COLORED PETRI NETS
Jeffrey J. Farah and Robert B. Kelley Aug. 1992 14 p Sponsored in part by AT and T Technologies, Inc.
(Grant NAGw-1333)
(NASA-CR-191853; NAS 1.26:191853; CIRSSE-123) Avail: CASI HC A03/MF A01

Previous work has introduced the Planning Coordinator (PCOORD), a coordinator functioning within the hierarchy of the Intelligent Machine Mode. Within the structure of the Planning Coordinator resides the Primitive Structure Database (PSDB) functioning to provide the primitive structures utilized by the Planning Coordinator in the establishing of error recovery or on-line path plans. This report further explores the Primitive Structure Database and establishes the potential of utilizing semantic networks as a means of efficiently storing and retrieving the Generalized Stochastic Colored Petri Nets from which the error recovery plans are derived. Author

N93-17036# Pacific Northwest Lab., Richland, WA.
A REVIEW OF SELECTED ENERGY-RELATED DATA SETS
A. K. Nicholls, D. B. Elliott, M. L. Jones, J. M. Hannifan, K. J. Degroat, M. J. Eichner, and J. E. King Sep. 1992 167 p
(Contract DE-AC06-76RL-01830)
(DE93-002180; PNL-8336) Avail: CASI HC A08/MF A02

DOE's Office of Planning and Assessment (OPA) performs crosscutting technical, policy, and environmental assessments of energy technologies and markets. To support these efforts, OPA is in the process of creating a data base management system (DBMS) that will include relevant data compiled from other sources. One of the first steps is a review of selected data sets that may be considered for inclusion in the DBMS. The review covered data sets in five categories: buildings-specific data; industry-specific data; transportation-specific data; utilities-specific data; and crosscutting/general data. Reviewed data sets covered a broad array of energy efficiency, renewable, and/or benchmark technologies. Most data

sets reviewed are sponsored by Federal government entities and major industry organizations. Additional data sets reviewed are sponsored by the states of California and New York and regional entities in the Pacific Northwest. Prior to full review, candidate data sets were screened for their utility to OPA. Screening criteria included requirements that a data set be particularly applicable to OPA's data needs, documented, current, and obtainable. To fully implement its DBMS, OPA will need to expand the review to other data sources, and must carefully consider the implications of differing assumptions and methodologies when comparing data. DOE

N93-17590# Universiteit Twente, Enschede (Netherlands).
SEMANTIC QUERY OPTIMIZATION IN DISTRIBUTED DATABASE SYSTEMS: A KNOWLEDGE-BASED APPROACH Ph.D. Thesis
Hendrikus Johannes A vanKuik 1991 200 p
(ISBN-90-9003849-3; ETN-92-92534) Copyright Avail: CASI HC A09/MF A03

An approach to semantic query optimization in distributed database systems is described. Query optimization is defined as searching for the most efficient query evaluation plan given a query expression, a database state, and the database system characteristics. This search program is recognized to be NP hard. The problem of searching the potentially large search spaces of equivalent expressions is attacked by a combination of multilevel search method and powerful heuristics. The problem of query optimization is decomposed into a number of basic transformation problems. A possible realization of the query optimizer as a knowledge system is discussed. ESA

N93-17592*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NASA/DOD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT. PAPER 25: THE IMPACT OF LANGUAGE AND CULTURE ON TECHNICAL COMMUNICATION IN JAPAN
John R. Kohl (Rensselaer Polytechnic Inst., Troy, NY.), Rebecca O. Barclay (Rensselaer Polytechnic Inst., Troy, NY.), Thomas E. Pinelli, Michael L. Keene (Tennessee Univ., Knoxville.), and John M. Kennedy (Indiana Univ., Bloomington.) 1993 13 p Repr. from Technical Communications, v. 40, no. 1, Feb. 1993 p 62-73 Sponsored in part by the Society for Technical Communications
(NASA-TM-108592; NAS 1.15:108592) Avail: CASI HC A03/MF A01

One of the most significant developments in the field of technical communication during the 1980's and 1990's has been a growing interest in international technical communication, including technical communication in Japan. This article provides insights into aspects of the Japanese language and culture that affect Japanese technical communication practices. These insights are then used to interpret and report the results of a survey of Japanese aerospace engineers and scientists concerning the kinds of communication products they produce, the kinds they use, and the specific recommendation they would offer to designers of academic programs in technical communication. Author

N93-17595# Nijmegen Univ. (Netherlands). Dept. of Informatics.
A RANDOMISED SCHEMA MUTATOR FOR EVOLUTIONARY DATABASE OPTIMISATION
Patrick vanBommel 14 Nov. 1991 14 p
(TR-91-24; ETN-92-92538) Avail: CASI HC A03/MF A01

A study which focuses on randomized evolutionary optimization is presented. A general framework for the optimization of data models, based on the concept of evolution, is introduced. This evolution is guided by a randomized schema mutator. Although the approach is expressed in terms of database optimization, the ideas are applicable to other fields of randomized evolutionary optimization of computer models, expecially when similar (graph structured) models are used. ESA

N93-17601# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Bereich Industrielle Messtechnik und Informationsverarbeitung.
DIRECT ACCESS AND EXTERNAL MEMORY MANAGEMENT OF MULTIMEDIA DOCUMENTS, AN OBJECT-ORIENTED APPROACH. PART 1: THE MODEL
Wolfgang R. Herzner, Erwin Hocevar, and Rainer Zoubek Dec. 1991 103 p
(OEFZS-4607-Pt-1; ETN-92-92619) Copyright Avail: CASI HC A06/MF A02

A system for direct access and external memory management which covers the needs of storing multimedia documents in multiuser and distributed environments is described. A model which comes as near as possible to the semantic structures of multimedia documents, and provides efficiency of storage and access mechanisms is required. The system should easily be handled, modified, and enlarged. Documents and their parts should be accessible through their properties. Associative methods for rapid access and encapsulation of data to minimize side effects ought to be supported. The concurrent access from multiple processes to the same document should be possible, as well as the use of multiple documents distributed over several locations, by one process. An object oriented data base approach is developed. It allows modeling of the complex reality of multimedia documents. The prototype implementation is described and demonstrates the applicability of the proposed approach. ESA

N93-17635# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Bereich Industrielle Messtechnik und Informationsverarbeitung.
DIRECT ACCESS AND EXTERNAL MEMORY MANAGEMENT OF MULTIMEDIA DOCUMENTS, AN OBJECT-ORIENTED APPROACH. PART 2: THE PROTOTYPE
Wolfgang R. Herzner, Erwin Hocevar, and Rainer Zoubek Dec. 1991 70 p
(OEFZS-4608-Pt-2; ETN-92-92620) Copyright Avail: CASI HC A04/MF A01

The prototype implementation of compound document access and management, a direct access and external memory management model, is presented. It covers the needs for storing multimedia documents in multiuser and distributed environments. The core of the prototype is constituted by a relational database, which holds all data about classes, instances, aggregations, and so on in a set of relations. Constraints control the consistency of manipulations. Around this, an object oriented respecting semantic database is simulated by a software shell, written in C. This shell provides two application interfaces: one 'pure' object oriented and a procedural interface provides access on a 'more lower level'. A demonstration environment is developed together with the 'audio and synchronization extension' project to show the synchronization of text and graphic of a document in combination with the audio content. ESA

N93-17661# Naval Postgraduate School, Monterey, CA.
ECONOMIC ANALYSIS OF REDESIGN ALTERNATIVES FOR THE RESFMS INFORMATION SYSTEM M.S. Thesis
Ron M. Richardson Sep. 1992 165 p
(AD-A257475) Avail: CASI HC A08/MF A02

This study is a practical example of economic analysis of information systems and of the software cost estimation problem as applied to software development in the Department of Defense. Economic analysis methods and the difficulty of software cost estimation are demonstrated using the proposed redesign of the Reserve Financial Management System (RESFMS), an information system operated by the U.S. Naval Reserve. The mandate for economic analysis in the Department of Defense and procedures applicable to information systems are discussed. Two alternatives are analyzed: the status quo and a redesign proposed by Commander Naval Reserve Force (COMNAVRESFOR). Costs to be considered for each alternative are described. Since the major cost of the redesign will be software development, the problem of software development cost estimation is discussed. An estimate of software development cost is produced. This estimate and other identified costs are used to calculate present value of savings, savings/investment ratio, and discounted payback period for the redesign alternative as compared to the status quo. Risk analysis, using a Monte Carlo simulation, is then performed to determine the range of possible outcome values and probabilities for each. The result of the economic analysis is a recommendation that RESFMS be redesigned as proposed by COMNAVRESFOR. GRA

N93-17665# Rome Lab., Griffiss AFB, NY.
PROGRAM 6 TECHNICAL INTERCHANGE MEETING PROCEEDINGS Report, 11-12 Feb. 1992
Walter Gadz and Patrick McCabe Oct. 1992 236 p
(AF Proj. 3481)
(AD-A257736; RL-TM-92-26) Avail: CASI HC A11/MF A03

The second annual Program 6 Technical Interchange Meeting (TIM) was held 11-12 February 1992. An informal symposium of contractors and

government personnel, the TIM fosters the interchange of ideas and encourages cooperation. The topics covered include the following: natural language understanding, intelligence data handling, heterogeneous database access, and neural networks. GRA

N93-17714# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
LOGIC AND THE FLOW OF INFORMATION
Johan vanBenthem Nov. 1991 35 p Submitted for publication
(LP-91-10; ETN-93-93102) Avail: CASI HC A03/MF A01

A general perspective on logic and the flow of information inspired by dynamic logic in computer science is presented and an attempt is made to identify some salient general logical issues emerging behind many specific systems for linguistic and general cognitive purposes published so far. Notably, a 'procedural turn' leads to a reappraisal of traditional notions like 'logical constant' and a 'valid inference', while also raising new issues of 'logical architecture'. Consideration, is given to a very general procedural logic and various possible specializations, showing that traditional methods of analysis still apply, when given an appropriate new twist. No specific system for performing the new cognitive tasks is proposed, concentration being placed on fundational issues concerning their design. ESA

N93-17763# Naval Postgraduate School, Monterey, CA.
VERSION AND VARIATION CONTROL OF A DESIGN DATABASE FOR A COMPUTER AIDED PROTOTYPING SYSTEM M.S. Thesis
Michael D. OLoughin 18 Jun. 1992 346 p
(AD-A257480) Avail: CASI HC A15/MF A03

The Computer Aided Prototyping System (CAPS) was created for rapidly prototyping real-time systems to determine early in the software development life cycle whether system requirements can be met. The CAPS consists of several software tools that automatically generate an executable Ada model of the proposed system. This thesis describes the development of a design database (DDB) for CAPS. The DDB is an engineering database that contains all the information related to a software prototype design. The DDB enhances the CAPS environment and the prototyping model by providing to the designer the capability to store, retrieve, view, edit, and control variation and versioning of the prototype components. This thesis describes the design, test, and implementation of a tree structure variation and version control method for supporting CAPS. GRA

N93-17768# Naval Postgraduate School, Monterey, CA.
SOFTWARE DEVELOPMENT WITH APPLICATION GENERATORS: THE NAVAL AVIATION LOGISTICS COMMAND MANAGEMENT INFORMATION SYSTEM CASE M.S. Thesis
Cheryl D. Blake Sep. 1992 63 p
(AD-A257624) Avail: CASI HC A04/MF A01

Information systems executives within Department of Defense (DoD) activities are being challenged to build information systems faster, and cheaper. A key step in developing information systems that will meet the future needs of DoD organizations is to explore innovative software development paradigms and exploit technological advances of application generators to produce information systems cost-effectively. This thesis examines the concepts, implementation strategies and issues relating to software development with application generators and illustrates, using a case study of the Naval Aviation Logistics Command Management Information System (NALCOMIS) prototyping development effort, the critical success factors required to implement prototyping with application generators in other areas of DoD. GRA

N93-17773# Defense Information Systems Agency, Arlington, VA. Center for Information Management.
TECHNICAL REFERENCE MODEL FOR INFORMATION MANAGEMENT, VERSION 1.2
John Keane 15 May 1992 93 p
(AD-A253476) Avail: CASI HC A05/MF A01

The Defense Information Systems Agency (DISA) Center for Information Management is responsible for developing an overall open systems architecture that ensures probability, interoperability, flexibility, scalability and cost-effectiveness of DoD information management systems. This open systems architecture is to be based on vendor-independent standards developed through open, public-consensus forums. The Technical Reference Model for Information Management (TRM) presents a profile of standards which is mandatory for all DoD information systems. As directed by-the Director of Defense Information, all major acquisitions will use the Technical Reference Model (Version 1.1) as the guideline for selecting appropriate standards. This document is Version 1.2 of the TRM. It provides an update to the reference model and profile of standards contained in the earlier version including: the the addition of FIPS Publication 161 (EDI), a limited discussion of Ada bindings, an initial recommendation on security standards, and a requirement for standards conformance testing. A new section contains a detailed discussion on the added security services and standards that actually apply across the entire Technical Reference Model. GRA

N93-17790# Naval Postgraduate School, Monterey, CA.
A FRAMEWORK FOR CLASSIFYING AND RESOLVING SEMANTIC HETEROGENEITY IN OBJECT-ORIENTED DATABASES M.S. Thesis
Michael T. Bourque Sep. 1992 108 p
(AD-A257597) Avail: CASI HC A06/MF A02

During the past three decades, many organizations have seen a dramatic proliferation of a variety of information systems. Organizations soon discovered the need to access and share data across these different information systems. Under current technology, this integration is usually not possible due to the heterogeneity of information systems. One level of heterogeneity is that of semantics. The objective of this thesis is to build a framework for enumerating, classifying, and resolving the types of semantic heterogeneity that could exist in an object-oriented database model. The framework covers both schema and data content conflicts. The schema conflicts are classified broadly by the level at which they occur. The primary data conflicts covered include inconsistencies and different representations for the same data. GRA

N93-17282*# Alabama A & M Univ., Huntsville. Dept. of Mathematics.
UPDATING AND EXPANDING THE LIBRARY OF MATERIALS ON NASA SPACELINK ELECTRONIC INFORMATION SYSTEM
Jean A. Blake *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 6 p (For primary document see N93-17279 05-80)
Avail: CASI HC A02/MF A03

N93-17316*# Alabama Univ., Huntsville. Dept. of Industrial Engineering.
DEVELOPMENT OF VENDOR EVALUATION CRITERIA AND POST-IMPLEMENTATION CONSIDERATIONS FOR MSFC CENTER-WIDE EXECUTIVE INFORMATION SYSTEM
Gary P. Moynihan *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N93-16847# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
DYNAMIC PATH CONTROLLABILITY IN ECONOMIC MODELS: FROM LINEARITY TO NONLINEARITY
W. C. A. Maas and H. Nijmeijer Apr. 1992 22 p
(MEMO-1047; ETN-92-92474) Avail: CASI HC A03/MF A01

The dynamic path controllability of discrete time nonlinear economic models in state space form is studied. An algorithmic procedure for testing this property for time varying linear systems is presented. This method is extended to general nonlinear models and it is shown that under generic conditions path controllability around a specific trajectory of the nonlinear system is equivalent to path controllability of the corresponding linearized model. The results are illustrated with two economic examples. ESA

N93-17745# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France). Service Etudes Logiciel.
THE CONTROL OF TEST COSTS: EXPERIENCE OF THE FADEC SOFTWARE [LA MAITRISE DES COUTS DE TEST: EXPERIENCE DU LOGICIEL FADEC]
Joseph Lleres 1990 10 p In FRENCH Presented at AAAF

Colloquium on Maitrise des Couts des Logiciels Embarques, Paris, France, 14-15 Jun. 1990
(ETN-93-93384) Avail: CASI HC A02/MF A01

The control of the cost when testing software is examined. The verification of the FADEC (Full Authority Digital Engine Control) software is taken as an example. The industrial context in which the software is developed is presented and a description of the means, methods and tools used is given. An assessment is made using the data of four certifications obtained between 1987 and 1989. ESA

N93-17325*# Pittsburgh State Univ., KS. Dept. of Engineering Technology.
INDUSTRY SURVEY OF SPACE SYSTEM COST BENEFITS FROM NEW WAYS OF DOING BUSINESS
Russell L. Rosmait *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 3 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N93-17089# Committee on Appropriations (U.S. Senate).
DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT AND INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1993, PART 1
Washington GPO 1992 904 p Hearings on H.R. 5679 before the Committee on Appropriations, 102nd Congress, 2nd Session, 21 Feb., 27 Feb., 5 Mar., and 25-26 Mar. 1992
(S-Hrg-102-716-Pt-1; GPO-52-798; ISBN-0-16-039017-6) Avail: CASI HC A99/MF A10; Subcommittee of the Committee on Appropriations, Senate, Washington, DC 20510 HC; SOD HC

This volume comprises the Senate hearings before the Committee on Appropriations for the Departments of Veterans Affairs and Housing and Urban Development and independent agencies appropriations (including NASA) for the fiscal year 1993. Other scientific agencies included are the Council on Environmental Quality, Environmental Protection Agency, National Science Foundation and the Office of Science and Technology Policy. For individual titles, see N93-17090 through N93-17091.

N93-17090# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Departments of Veterans Affairs and Housing and Urban Development and Independent Agencies Appropriations for Fiscal Year 1993, Part 1 1992 p 1-49 (For primary document see N93-17089 05-84)
Avail: CASI HC A03/MF A10; Subcommittee of the Committee on Appropriations, Senate, Washington, DC 20510 HC; SOD HC

One of two NASA sections of H.R. 5679 that deals with NASA, this section explores what civilian space assets exist in the former Soviet Union. After opening statements, the testimony is followed by statements from a representative of the Department of State. Finally a panel on the Russian space program made up of Russian space experts presents testimony. Some specific topics treated in the Senate Hearings are automatic rendezvous and docking system, civil space policy, Soviet/United States cooperation, future of soviet scientists, and solar sails. R.L.B.

N93-17091# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Departments of Veterans Affairs and Housing and Urban Development and Independent Agencies Appropriations for Fiscal Year 1993, Part 1 1992 p 427-669 (For primary document see N93-17089 05-84)
Avail: CASI HC A11/MF A10; Subcommittee of the Committee on Appropriations, Senate, Washington, DC 20510 HC; SOD HC

This second of two NASA parts of H.R. 5679 presents testimony to review the proposed fiscal year 1993 NASA budget. Some specific budget items discussed were the Space Station Freedom, the Assured Crew Return Vehicle, the Advanced Solid Rocket Motor, the National Aerospace Plane (NASP), the Landsat program, aeronautical research and technology, the American space program and U.S. competitiveness. Questions and answers regarding the NASA budget are then presented. As part of the testimony, the Payload Flight Assignments, NASA Mixed Fleet for January 1992 is included. Participants of the JOVE program (NASA/university joint venture in space sciences) are included. Also listed are the participants in the NASA Space Grant College and Fellowship Program. R.L.B.

N93-16860*# Texas Univ., Austin.
SPACE LAW AND SPACE RESOURCES
Nathan C. Goldman *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 143-153 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N93-15704# General Accounting Office, Washington, DC. Resources Community and Economic Development Div.
TECHNOLOGY TRANSFER: FEDERAL EFFORTS TO ENHANCE THE COMPETITIVENESS OF SMALL MANUFACTURERS
Nov. 1991 47 p
(AD-A256804; GAO/RCED-9230) Avail: CASI HC A03/MF A01

Efforts were made by the federal government to enhance the competitiveness of small businesses by easing the transfer of technology from research and developmental efforts of the government. These efforts are examined. E.R.

N93-15712*# National Aeronautics and Space Administration, Washington, DC. Life Sciences Div.
EARTH BENEFITS FROM NASA RESEARCH AND TECHNOLOGY. LIFE SCIENCES APPLICATIONS
Oct. 1991 36 p
(NASA-TM-108043; NAS 1.15:108043) Avail: CASI HC A03/MF A01

This document provides a representative sampling of examples of Earth benefits in life-sciences-related applications, primarily in the area of medicine and health care, but also in agricultural productivity, environmental monitoring and safety, and the environment. This brochure is not intended as an exhaustive listing, but as an overview to acquaint the reader with the breadth of areas in which the space life sciences have, in one way or another, contributed a unique perspective to the solution of problems on Earth. Most of the examples cited were derived directly from space life sciences research and technology. Some examples resulted from other space technologies, but have found important life sciences applications on Earth. And, finally, we have included several areas in which Earth benefits are anticipated from biomedical and biological research conducted in support of future human exploration missions. Author

N93-15941# Department of Agriculture, Washington, DC.
NATIONAL TECHNOLOGY INITIATIVE SUMMARY PROCEEDINGS
Oct. 1992 62 p Prepared in cooperation with Dept. of Commerce, DOE, NASA, and DOT
(DE93-001291; NTI-93001291) Avail: CASI HC A04/MF A01

The National Technology Initiative (NTI) was launched on 12 Feb. 1992, at a conference in Cambridge, Massachusetts, the first of ten regional conferences held across the country over the ensuing six months. President Bush issued a statement on that date making the NTI a presidential initiative. Five more conferences are planned for late 1992. This interim report covers the result's of the first ten conferences. The goal of the NTI is to promote U.S. technological competitiveness through a more effective industry/government partnership. The ten 'town meetings' brought together

more than 3500 representatives principally from high technology industries, federal laboratories, universities, and government to create a better understanding of how firms can commercialize new technological innovations more quickly and effectively. Each conference was designed to address specific, regionally-significant areas of technology, such as materials, electronics, environment, communications, biotechnology, and aerospace, and included a 'tech fair' with exhibits staffed by federal agencies, universities and laboratories. Principal sponsors of the NTI are the Departments of Commerce (DOC), Energy (DOE) and Transportation (DOT), and NASA. Other participating federal agencies are as follows: the Departments of Agriculture, Defense, Health and Human Services, and Interior; the Environmental Protection Agency; and the Office of Science and Technology Policy. Recognizing that the commercialization of new technology is dependent on a number of interrelated business considerations, each conference covered three principal topics which affect the cost and speed of innovation: cooperative research and development, R&D financing, and manufacturing. DOE

N93-16577# Cranfield Inst. of Tech., Bedford (England). Centre for Logistics and Transportation.

AN EVALUATION OF THE POTENTIAL DECONGESTIVE EFFECT OF HIGH SPEED TRAINS TO EUROPE ON HEATHROW AND GATWICK AIRPORTS (UNITED KINGDOM) M.S. Thesis

J. M. Thomas Sep. 1991 143 p

(ETN-92-92774) Copyright Avail: CASI HC A07/MF A02

A study to evaluate the potential decongestive effect of high speed train links from the United Kingdom to Paris (France), Brussels (Belgium) and Amsterdam (Netherlands) on Heathrow and Gatwick airports in 1995 and 2000 is reported. The methodology follows a simple stepped approach of air traffic growth forecasting, modal split analysis, and the assessment of the traffic diverted to rail in terms of the reduction of passengers and passenger air transport movements. The findings suggest that although the decongestive effect is significant, the diversion levels vary considerably depending upon the passenger's reasons for travel. The main determinants of modal transfer, and thus decongestive effect in Heathrow and Gatwick, will be the degree of competitiveness of high speed rail fares, as yet an unknown quantity, and the levels and standards of service offered. ESA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N93-16181# Los Alamos National Lab., NM.

ULTRAVIOLET STUDIES OF NOVAE IN THE LARGE MAGELLANIC CLOUD

S. Starrfield and P. H. Hauschildt 1992 15 p Presented at the New Aspects of Magellanic Cloud Research, Heidelburg (Germany), 15-17 Jun. 1992

(Contract W-7405-eng-36)

(DE92-040348; LA-UR-92-2547; CONF-9206268-1) Avail: CASI HC A03/MF A01

We report on the ultraviolet observations of five novae in the LMC. They are as follows: LMC1988 no. 1, which was a CO nova similar to OS, and LMC 1988 no. 2, which was an ONeMg nova similar to Nova Her 1991; LMC 1990 no. 1, which was a very fast ONeMg nova similar to V693 CrA 1981; LMC 1990 no. 2, which was a recurrent nova similar to U Sco; and LMC 1991 which reached V approximately 9. DOE

N93-16949*# Space Telescope Science Inst., Baltimore, MD.

HUBBLE SPACE TELESCOPE: THE GO AND GTO OBSERVING PROGRAMS, VERSION 3.0

Ron Downes Jun. 1992 753 p

(NASA-CR-191290; NAS 1.26:191290) Avail: CASI HC A99/MF A06

A portion of the observing time with the Hubble Space Telescope (HST) was awarded by NASA to scientists involved in the development of the HST and its instruments. These scientists are the Guaranteed Time Observers (GTO's). Observing time was also awarded to General Observers (GO's) on the basis of the proposal reviews in 1989 and 1991. The majority of the 1989 programs have been completed during 'Cycle 1', while the 1991 programs will be completed during 'Cycle 2', nominally a 12-month period beginning July 1992. This document presents abstracts of these GO and GTO programs, and detailed listings of the specific targets and exposures contained in them. These programs and exposures are protected by NASA policy, as detailed in the HST Call for Proposals (CP), and are not to be duplicated by new programs. Author

N93-17029*# Washington Univ., Seattle. Dept. of Astronomy.

INTERNATIONAL ULTRAVIOLET EXPLORER (IUE) Final Technical Report, 1980 - 1992

Karl-Heinz Boehm 1992 9 p

(Grant NAG5-45)

(NASA-CR-191952; NAS 1.26:191952) Avail: CASI HC A02/MF A01

The observation, data reduction, and interpretation of ultraviolet spectra (obtained with the International Ultraviolet Explorer) of Herbig-Haro objects, stellar jets, and (in a few cases) reflection nebulae in star-forming regions is discussed. Intermediate results have been reported in the required semi-annual reports. The observations for this research were obtained in 23 (US1) IUE shifts. The spectra were taken in the low resolution mode with the large aperture. The following topics were investigated: (1) detection of UV spectra of high excitation Herbig-Haro (HH) objects, identification of emission lines, and a preliminary study of the energy distribution of the ultraviolet continuum; (2) details of the continuum energy distribution of these spectra and their possible interpretation; (3) the properties of the reddening (extinction) of HH objects; (4) the possible time variation of strong emission lines in high excitation HH objects; (5) the ultraviolet emission of low excitation HH objects, especially in the fluorescent lines of the H2 molecule; (6) the ultraviolet emission in the peculiar object HH24; (7) the spatial emission distribution of different lines and different parts of the continuum in different HH objects; and (8) some properties of reflection nebula, in the environment of Herbig-Haro objects. Each topic is discussed. Author

N93-17354# Lawrence Livermore National Lab., CA.

SODIUM GUIDE STAR ADAPTIVE OPTICS SYSTEM FOR ASTRONOMICAL IMAGING IN THE VISIBLE AND NEAR-INFRARED

D. T. Gavel, J. R. Morris, and R. G. Vernon (Science Applications International Corp., Palm Beach Gardens, FL.) Aug. 1992 3 p Presented at the Nonlinear Optics: Materials, Fundamentals, and Applications, Maui, HI, 17-21 Aug. 1992

(Contract W-7405-eng-48)

(DE92-041081; UCRL-JC-109606-R1; CONF-920853-4) Avail: CASI HC A01/MF A01

We are building an adaptive-optic telescope system that is based on the use of an artificial guide star created by laser-induced fluorescence of the sodium mesospheric layer. This paper discusses the system design for mid-visible to near-infrared compensation of a one meter telescope at Livermore and near-infrared compensation of the ten meter Keck telescope at Mauna Kea. We calculate the expected Strehl ratio and resolution for a 69 channel deformable mirror system and also for a possible 24 channel system upgrade. With the 69 actuator system we expect near diffraction limited resolution, about 0.2 arcsec, with a Strehl ratio of about 0.5 at gamma = 0.8 micron on the 1 m telescope and resolution of about 0.05 arcsec with a Strehl ratio of about 0.5 at gamma = 2.0 microns on the 10 m telescope. Resolution will be limited by the performance of the tip/tilt correction loop, which uses an off-axis natural guide star as a reference. At Livermore, our design uses an existing high power (1 kW) laser source, which is expected to provide an approximately 6th magnitude artificial guide star. This strong beacon signal allows a short integration time in the wavefront sensor so that temporal changes in the atmospheric

turbulence can be tracked accurately. For Mauna Kea, we explore how the system to be built for the Livermore site would perform in the infrared, assuming a 100 W laser source. DOE

N93-17401*# Columbia Univ., New York, NY. Dept. of Astronomy and Physics.
IMAGING THE NEARBY SEYFERT 2 GALAXY NGC 1068, AND SPECTRUM AND VARIABILITY OF GEMINGA Annual Status Report, 1 Jun. 1991 - 31 Dec. 1992
Jules P. Halpern 11 Jan. 1993 36 p
(Grant NAG5-1606)
(NASA-CR-191905; NAS 1.26:191905; CAL-2044) Avail: CASI HC A03/MF A01

The results of the research for NASA Grant NAG5-1606 are summarized in the following publications: (1) A ROSAT high resolution image of NGC 1068; (2) Discovery of soft x-ray pulsations from the gamma-ray source Geminga; and (3) Soft x-ray properties of the Geminga pulsar. For individual titles, see N93-17402 through N93-17403.

N93-17402*# Columbia Univ., New York, NY.
A ROSAT HIGH RESOLUTION X RAY IMAGE OF NGC 1068
J. Halpern *In its* Imaging the Nearby Seyfert 2 Galaxy NGC 1068, and Spectrum and Variability of Geminga 11 Jan. 1993 4 p (For primary document see N93-17401 05-89)
Avail: CASI HC A01/MF A01

The soft x ray properties of the Seyfert 2 galaxy NGC 1068 are a crucial test of the 'hidden Seyfert 1' model. It is important to determine whether the soft x rays come from the nucleus, or from a number of other possible regions in the circumnuclear starburst disk. We present preliminary results of a ROSAT HRI observation of NGC 1068 obtained during the verification phase. The fraction of x rays that can be attributed to the nucleus is about 70 percent so the 'soft x ray problem' remains. There is also significant diffuse x ray flux on arcminute scales, which may be related to the 'diffuse ionized medium' seen in optical emission lines, and the highly ionized Fe K(alpha) emission seen by BBXRT. Author

N93-17403*# Columbia Univ., New York, NY.
SOFT X RAY PROPERTIES OF THE GEMINGA PULSAR
J. P. Halpern and M. Ruderman *In its* Imaging the Nearby Seyfert 2 Galaxy NGC 1068, and Spectrum and Variability of Geminga 11 Jan. 1993 27 p Submitted for publication to The Astrophysical Journal (For primary document see N93-17401 05-89)
Avail: CASI HC A03/MF A01

The ROSAT soft x ray spectrum and pulse profile of the Geminga pulsar are analyzed and interpreted in terms of thermal emission from the surface of the neutron star. The x ray spectrum appears to consist of two blackbody components with T(sub 1) = (5.2 +/- 1.0) x 10 (exp 5) K and T(sub 2) approximately 3 x 10(exp 6) K, respectively. The inferred ratio of surface areas, A(sub 2)/A(sub 1), is approximately 3 x 10(exp -5). Both components are highly modulated at the pulsar rotation period, but the harder x ray pulse is narrower, and leads the main (soft) x ray pulse by about 105 deg of phase. The soft x ray component is interpreted as photospheric cooling of much of the neutron star's surface area, while the small, hot region could be part of the much smaller polar cap heated by energetic particles flowing inward from the magnetospheric accelerator which is responsible for the production of Geminga's gamma rays. Geminga's gamma ray emission is consistent with outer-magnetosphere accelerator models for highly inclined dipoles. These predict the beaming of energetic gamma rays close enough to the star to give copious e(+/-) production in the stellar magnetic field and a large circumstellar pair density from pair inflow toward the surface. These pairs may quench radio emission, and also reflect most of the hard polar cap x rays back to the stellar surface by cyclotron resonance scattering. They are then reemitted from that much larger area at the lower temperature T(sub 1). The single-peaked nature of the x ray pulse and its energy-dependent phase suggest an off-center dipole geometry for the surface magnetic field. Under the assumption that the soft x ray emission comes from the full surface of a neutron star of radius R = 10 km, a distance estimate of (150-400) pc is derived. This range is consistent with the fit interstellar column density of (1.5 +/- 0.5) x 10(exp 20) cm(exp -2). Distances less than 150 pc are probably ruled out both by the lower limit on the column density, and also by the requirement that the Rayleigh-Jeans extrapolation of the soft x ray spectrum not exceed the observed blue flux of the faint optical counterpart. This distance estimate implies that Geminga's efficiency for converting spindown power into gamma-rays is near unity, and that there may be significant beaming of the gamma rays as well. These results tend to bolster the prospect that most of the unidentified high-energy gamma ray sources in the Galactic plane are pulsars, some of which may be radio quiet. Author

N93-15752# Maschinenfabrik Augsburg-Nuernberg A.G., Augsburg (Germany).
DEVELOPMENT, MANUFACTURING AND ALIGNMENT OF 2 m DIAMETER MIRROR FOR PRONAOS
F. Hofbauer, M. Duran (MATRA Espace, Toulouse, France), and Ph. Luquet (MATRA Espace, Toulouse, France) *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 737-742 (For primary document see N93-15718 05-18)
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ORFEUS CFRP STRUCTURE: A HIGH STIFFNESS-LOW THERMAL STRAIN SPACE TELESCOPE STRUCTURE
Thomas Schaeffler *In* ESA, Spacecraft Structures and Mechanical Testing, Volume 2 Oct. 1991 p 893-899 (For primary document see N93-15718 05-18)
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N93-16879*# Rensselaer Polytechnic Inst., Troy, NY.
GROUND-BASED OBSERVATION OF NEAR-EARTH ASTEROIDS
Michael J. Gaffey *In* NASA. John Space Center, Space Resources. Volume 3: Materials 1992 p 50-58 (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

N93-17095# Leicester Univ. (England). Dept. of Physics and Astronomy.
GINGA AND ROSAT OBSERVATIONS OF THE X RAY SPECTRA OF SEYFERT 1 GALAXIES
K. A. Pounds, K. Nandra, and G. C. Stewart *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 1-16 (For primary document see N93-17094 05-90)
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N93-17097# Cambridge Univ. (England). Inst. of Astronomy.
OBSERVATIONAL CONSTRAINTS ON AGN MODELS
A. C. Fabian *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 22-35 (For primary document see N93-17094 05-90)
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N93-17100# Centre d'Essais de Propulseurs, Saclay (France). Centre d'Etudes Nucleaires.
HARD X RAY OBSERVATIONS OF ACTIVE GALACTIC NUCLEI WITH SIGMA
J. Ballet, F. Lebrun, J. Paul, A. Claret, E. Jourdain (Centre d'Etude Spatiale des Rayonnements, Toulouse, France), L. Bassani (Centre d'Etude Spatiale des Rayonnements, Toulouse, France), L. Bouchet (Centre d'Etude Spatiale des Rayonnements, Toulouse, France), P. Mandrou (Centre d'Etude Spatiale des Rayonnements, Toulouse, France), R. Sunyaev (Academy of Sciences, USSR, Moscow), and E. Churazov (Academy of Sciences, USSR, Moscow) et al *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 50-53 (For primary document see N93-17094 05-90)
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OBSERVING AGN AND DXRB WITH XSPECT/SODART
Niels Joergen Westergaard and Hans Ulrik Noergaard-Nielsen *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 62-65 (For primary document see N93-17094 05-90)
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N93-17104*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CORRELATED HARD X RAY AND UV VARIABILITY IN NGC 5548
J. Clavel (European Space Research Lab., Noordwijk, Netherlands), K. Nandra (Leicester Univ., England), F. Makino (Tokyo Univ., Sagamihara, Japan), K. A. Pounds (Leicester Univ., England), G. A. Reichert, C. M. Urry (Space Telescope Science Inst., Baltimore, MD.), W. Wamsteker (European Space Agency. ESA Tracking Station, Madrid, Spain), M. Peracaula-Bosch, and G. C. Stewart (Leicester Univ., England) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 66-73 (For primary document see N93-17094 05-90)
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N93-17106*# Seattle Univ., WA. Dept. of Astronomy.
THE X RAY PROPERTIES OF A LARGE, UNIFORM QSO SAMPLE: EINSTEIN OBSERVATIONS OF THE LBQS
B. Margon, S. F. Anderson, X. Xu, P. J. Green, and C. B. Foltz (Arizona Univ., Tucson.) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 81-84 (For primary document see N93-17094 05-90)
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N93-17107*# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
EXTRAGALACTIC COUNTERPARTS TO EINSTEIN SLEW SURVEY SOURCES
Jonathan F. Schachter, Martin Elvis, David Plummer, and Ron Remillard (Massachusetts Inst. of Tech., Cambridge.) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 85-90 (For primary document see N93-17094 05-90)
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N93-17109# Landessternwarte auf dem Koenigstuhl, Heidelberg (Germany).
MULTIFREQUENCY OBSERVATIONS OF RAPIDLY VARIABLE BLAZARS
Stefan J. Wagner *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 97-102 Sponsored by Sonderforschungsbereich 328 (For primary document see N93-17094 05-90)
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ROSAT OBSERVATIONS OF AGN
Wolfgang Brinkmann *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 143-154 Sponsored by BMFT (For primary document see N93-17094 05-90)
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MULTIFREQUENCY OBSERVATIONS OF ROSAT SELECTED RADIO SOURCES
M. Neumann, W. Reich, E. Fuerst, W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), P. Reich, R. Wielebinski, H. H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), and J. Truemper (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 163-168 (For primary document see N93-17094 05-90)
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N93-17119# European Space Agency, Garching (Germany).
THE QUASAR 1821+643 DURING THE ROSAT SURVEY
M.-H. Ulrich, H. H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), S. Schaeidt (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), M. Kolman (Columbia Univ., New York, NY.), M. A. Malkan (California Univ., Los Angeles.), L. Maraschi (Milan Univ., Italy), A. Treves (Milan Univ., Italy), and S. Wagner (Landessternwarte auf dem Koenigstuhl, Heidelberg, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 169-174 (For primary document see N93-17094 05-90)
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N93-17120# SISSA, Trieste (Italy).
MULTIFREQUENCY OBSERVATIONS OF KAZ 102 DURING ROSAT ALL SKY SURVEY
A. Treves, H. H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), M. Malkan (California Univ., Los Angeles.), L. Maraschi (Milan Univ., Italy), M. H. Ulrich (European Space Agency, Garching, Germany), W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), D. deMartino (European Space Agency. ESA Tracking Station, Madrid, Spain), M. Elvis (Smithsonian Astrophysical Observatory, Cambridge, MA.), J. Heidt (Landessternwarte auf dem Koenigstuhl, Heidelberg, Germany), and J. McDowell (Smithsonian Astrophysical Observatory, Cambridge, MA.) et al *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 175-180 (For primary document see N93-17094 05-90)
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ROSAT AND MULTI-WAVELENGTH OBSERVATIONS OF 3C 371
H. H. Fink, M. Malkan (California Univ., Los Angeles.), A. Treves (SISSA, Trieste, Italy), M.-H. Ulrich (European Space Agency, Garching, Germany), L. Maraschi (Milan Univ., Italy), S. Schaeidt, F. Baganoff (California Univ., Los Angeles.), W. Brinkmann, G. Hartner, and L. Morbidelli (Consiglio Nazionale delle Ricerche, Florence, Italy) et al *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 181-186 (For primary document see N93-17094 05-90)
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A DEEP ROSAT OBSERVATION OF THE HIGHLY VARIABLE AGN 1E1403+5439 OR ROSAT NON-DETECTION OF THE WEAK AGN 1E1403+5439
T. Belloni and S. L. Snowden (Wisconsin Univ., Madison.) *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 187-190 (For primary document see N93-17094 05-90)
(Grant NAG5-1438)
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N93-17124# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
A COMPARATIVE STUDY OF SOFT X RAY QSO SPECTRA
N. Schartel, H. Fink, W. Brinkmann, and J. Truemper *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 195-197 (For primary document see N93-17094 05-90)
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N93-17125# Tuebingen Univ. (Germany). Astronomisches Inst.
SPECTRA OF RADIO-LOUD QUASARS OBSERVED IN THE ROSAT/XRT ALL SKY SURVEY
Hermann Brunner, Peter Friedrich, Hans-Ulrich Zimmermann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), and Ruediger Staubert *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 198-201 (For primary document see N93-17094 05-90)
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N93-17126# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
X RAY SPECTRA OF BRIGHT BL LACERTAE OBJECTS OBSERVED WITH ROSAT
H. H. Fink, H.-C. Thomas (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), W. Brinkmann, R. Okayasu (Institute of Physical and

Chemical Research, Saitama, Japan), and G. Hartner *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 202-205 (For primary document see N93-17094 05-90)
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PRELIMINARY RESULTS ON ROSAT OBSERVATIONS OF THE BLAZAR PKS 0537-441
A. Treves, T. Belloni (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), R. Falomo (Osservatorio Astronomico, Padova, Italy), H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), L. Maraschi (Milan Univ., Italy), and H. U. Zimmermann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany) *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 206-209 (For primary document see N93-17094 05-90)
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N93-17128# Cambridge Univ. (England). Center for Astrophysics.
ROSAT X RAY SPECTRA OF QUASARS WITH A RANGE OF CONTINUUM PROPERTIES AND REDSHIFT
Belinda J. Wilkes, Martin S. Elvis, Harvey Tananbaum, Jonathan C. McDowell, and Andrew Lawrence (London Univ., England) *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 210-215 (For primary document see N93-17094 05-90)
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N93-17129# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
PRELIMINARY RESULTS ON THE PROPERTIES OF THE EMSS AGN'S AS DERIVED FROM THE ROSAT ALL SKY SURVEY
S. Molendi (Milan Univ., Italy), W. Brinkmann, and T. Maccacaro (Osservatorio Astronomico, Brera, Milan, Italy) *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 216-219 (For primary document see N93-17094 05-90)
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N93-17130# Tuebingen Univ. (Germany). Astronomisches Inst.
SOURCE CONTENT OF A DEEP POINTED ROSAT OBSERVATION AT VERY LOW N(SUB H)
Georg Lamer, Ruediger Staubert, and Hermann Brunner *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 220-223 (For primary document see N93-17094 05-90)
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N93-17131# Birmingham Univ. (England). School of Physics and Space Research.
PRELIMINARY RESULTS FROM THE ROSAT WFC ALL SKY SURVEY: A SAMPLE OF LOW GALACTIC COLUMN DENSITY AGN'S
Monika Balucinska-Church and P. Gondhalekar (Rutherford Appleton Lab., Chilton, England) *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 224-226 (For primary document see N93-17094 05-90)
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N93-17132*# Washington Univ., Seattle.
INITIAL RESULTS FROM A ROSAT DEEP SURVEY IN LYNX
S. F. Anderson, R. A. Windhorst (Arizona State Univ., Tempe.), T. Maccacaro (Osservatorio Astronomico, Brera, Milan, Italy), D. Burstein (Arizona State Univ., Tempe.), B. E. Franklin (Arizona State Univ., Tempe.), R. E. Griffiths (Space Telescope Science Inst., Baltimore, MD.), D. C. Koo (Lick Observatory, Santa Cruz, CA.), D. F. Mathis (Arizona State Univ., Tempe.), W. A. Morgan (Pennsylvania State Univ., University Park.), and L. W. Neuschaefer (Arizona State Univ., Tempe.) *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 227-230 Sponsored in part by Alfred P. Sloan Foundation (For primary document see N93-17094 05-90)
(Grants NAG5-1623; NAG5-1630; NAG1-455; NSF AST-88-21016)
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N93-17133# Academy of Sciences, Potsdam (German D.R.).
ROSAT ALL SKY SURVEY OBSERVATIONS OF IRAS GALAXIES
T. Boller (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), E. J. A. Meurs (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), U. Zimmermann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), and H.-M. Adorf (European Southern Observatory, Garching, Germany) *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 231-234 (For primary document see N93-17094 05-90)
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N93-17135# Universidad Complutense, Madrid (Spain). Lab. de Astrofisica Espacial y Fisica Fundamental.
SOFT X RAY SEGREGATION OF SEYFERT GALAXIES
J. Miguel Mas-Hesse, I. F. Mirabel (Commissariat a l'Energie Atomique, Saclay, France), and H. U. Zimmermann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 238-241 (For primary document see N93-17094 05-90)
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A NEW LOOK AT RADIO/X RAY CORRELATIONS
R. S. Warwick and C. R. Barber *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 242-246 (For primary document see N93-17094 05-90)
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THE 10-YEAR MONITORING OF THE COMPACT RADIO SOURCES IN THE NUCLEAR REGIONS OF M82
Philipp P. Kronberg and Richard A. Sramek (National Radio Astronomy Observatory, Tucson, AZ.) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 247-254 (For primary document see N93-17094 05-90)
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ROSAT DEEP SURVEYS
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N93-17154# Hamburger Sternwarte G.m.b.H. (Germany).
IDENTIFICATION OF ROSAT AGN ON OBJECTIVE PRISM PLATES
N. Bade, M. Dahlem, D. Engels, D. Reimers, and W. Voges (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 377-382 (For primary document see N93-17094 05-90)
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N93-17155# Max-Planck-Inst. fuer Astrophysik, Garching (Germany).
SPECTROSCOPIC IDENTIFICATION OF X RAY SOFT AGN FOUND BY ROSAT
C.-C. Thomas, K. Beuermann (Technische Univ., Berlin, Germany), W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), H. H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), and W. Voges (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 383-386 (For primary document see

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SELECTION OF FAINT QUASARS BASED ON VARIABILITY
A. Cimatti, G. Zamorani (Osservatorio Astronomico, Bologna, Italy), and B. Marano (Osservatorio Astronomico, Bologna, Italy) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 387-391 (For primary document see N93-17094 05-90)
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OPTICALLY SELECTED QUASARS WITH Z GREATER THAN 4
R. G. McMahon, M. J. Irwin (Royal Greenwich Observatory, Cambridge, England), and C. Hazard (Pittsburgh Univ., PA.) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 399-407 (For primary document see N93-17094 05-90)
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THE BALDWIN EFFECT IN COMPLETE OPTICALLY SELECTED SAMPLES OF QUASARS
Bruno Marano, Giovanni Zamorani (Consiglio Nazionale delle Ricerche, Bologna, Italy), Valentina Zitelli (Bologna Univ., Italy), Marco Mignoli (Bologna Univ., Italy), and Brian J. Boyle (Cambridge Univ., England) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 408-413 Sponsored in part by Italian Space Agency (For primary document see N93-17094 05-90)
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N93-17313*# New Mexico State Univ., University Park. Dept. of Astronomy.
CORRELATED OPTICAL OBSERVATIONS WITH BATSE/CGRO ON SCO X-1
Bernard McNamara *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17330*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
CONTROL-STRUCTURE-THERMAL INTERACTIONS IN ANALYSIS OF LUNAR TELESCOPES
Roger C. Thompson *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

N93-17434*# Hawaii Univ., Honolulu. Planetary Geoscience Div.
ASTRONOMY ON THE MOON: GEOLOGICAL CONSIDERATIONS
G. Jeffrey Taylor *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 183-187 (For primary document see N93-17414 05-91)
(SOEST-Contrib-2399; PGD-Contrib-630) Avail: CASI HC A01/MF A03

N93-17451*# New Mexico State Univ., Las Cruces. Dept. of Astronomy
SOME ASTRONOMICAL CHALLENGES FOR THE TWENTY-FIRST CENTURY
Jack O. Burns *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 315-319 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

N93-17452*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RADIO ASTROMETRY FROM THE MOON
R. P. Linfield *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 321-322 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

N93-17453*# BDM International, Inc., Albuquerque, NM.
REQUIRED TECHNOLOGIES FOR LUNAR ASTRONOMICAL OBSERVATORIES
Stewart W. Johnson and John P. Wetzel *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 323-328 (For primary document see N93-17414 05-91)
(Grant NAG9-245)
Avail: CASI HC A02/MF A03

N93-17454*# BDM International, Inc., Albuquerque, NM.
ENVIRONMENTAL EFFECTS ON LUNAR ASTRONOMICAL OBSERVATORIES
Stewart W. Johnson, G. Jeffrey Taylor (Hawaii Univ., Manoa.), and John P. Wetzel *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 329-335 (For primary document see N93-17414 05-91)
(Grant NAG9-245)
Avail: CASI HC A02/MF A03

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

For related information see also *75 Plasma Physics*.

N93-15690*# Rupprecht and Patashnick Co., Inc., Albany, NY.
A TEOM (TM) PARTICULATE MONITOR FOR COMET DUST, NEAR EARTH SPACE, AND PLANETARY ATMOSPHERES Final Report
Apr. 1988 73 p
(Contract NAS7-962)
(NASA-CR-190868; NAS 1.26:190868) Avail: CASI HC A04/MF A01

Scientific missions to comets, near earth space, and planetary atmospheres require particulate and mass accumulation instrumentation for both scientific and navigation purposes. The Rupprecht & Patashnick tapered element oscillating microbalance can accurately measure both mass flux and mass distribution of particulates over a wide range of particle sizes and loadings. Individual particles of milligram size down to a few picograms can be resolved and counted, and the accumulation of smaller particles or molecular deposition can be accurately measured using the sensors perfected and toughened under this contract. No other sensor has the dynamic range or sensitivity attained by these picogram direct mass measurement sensors. The purpose of this contract was to develop and implement reliable and repeatable manufacturing methods; build and test prototype sensors; and outline a quality control program. A dust 'thrower' was to be designed and built, and used to verify performance. Characterization and improvement of the optical motion detection system and drive feedback circuitry was to be undertaken, with emphasis on reliability, low noise, and low power consumption. All the goals of the contract were met or exceeded. An automated glass puller was built and used to make repeatable tapered elements. Materials and assembly methods were standardized, and controllers and calibrated fixtures were developed and used in all phases of preparing, coating and assembling the sensors. Quality control and reliability resulted from the use of calibrated manufacturing equipment with measurable working parameters. Thermal and vibration testing of completed prototypes showed low temperature sensitivity and high vibration tolerance. An electrostatic dust thrower was used in vacuum to throw particles from 2 x 10(exp 6) g to 7 x 10(exp -12) g in size. Using long averaging times, particles as small as 0.7 to 4 x 10(exp 11) g were weighted to resolutions in the 5 to 9 x 10(exp -13) g range. The drive circuit and optics systems were developed beyond what was anticipated in the contract, and are now virtually flight prototypes. There is already commercial interest in the developed capability of measuring picogram mass losses and gains. One area is contamination and outgassing research, both measuring picogram losses from samples and collecting products of outgassing. Author

N93-15918# California Univ., Berkeley. Lawrence Berkeley Lab.
MEASURING q(SUB 0) USING SUPERNOVAE AT z APPROXIMATELY 0.2 Ph.D. Thesis

H. J. M. Newberg Jul. 1992 112 p
(Contract DE-AC03-76SF-00098)
(DE92-041164; LBL-32634) Avail: CASI HC A06/MF A02

The measurement of q(sub 0) is extremely important for understanding the quantity of matter in our universe. The measurement of q(sub 0) using supernovae of type Ia as standard candles is appealing because it requires less modeling than other methods using galaxies. The challenge with using supernovae to measure q(sub 0) is in finding enough of them. In order to find supernovas, we have constructed a very popular f/1 camera for the 3.9m Anglo-Australian Telescope. The camera uses reducing optics that put a 17 in. times 17 in. field on a 1024 times 1024 pixel Thomson CCD. Using this system, we image to 23rd magnitude in five minutes. We have developed a software package that uses image subtraction to find supernovae that are approximately magnitude 22.4 or brighter in these images. One field can be processed every 6.6 minutes on a relatively unloaded VAX 6000-6510. We estimate that this system should find one supernova in every 105-139 images (about two nights of observation on the AAT). Throughout the two years of operation, we observed the equivalent of about four nights with seeing better than two arc seconds. Although we found many candidates, we were unable to confirm any supernovae. The next generation of this search is currently using the 2.5m Isaac Newton Telescope in the Canary Islands. We have solved many problems encountered with the AAT search by targeting distant clusters of galaxies, by operating at a site that allows higher resolution imaging, and by scheduling follow-up observations. This system, although still in its infancy, has yielded one event that could be a high redshift supernova. We estimate that it will require 36 type Ia supernovae, discovered at or before maximum, to find q(sub 0) to within 0.2, and 144 such supernovae to measure q(sub 0) within 0.1. Clearly, the program will have to be expanded to find this quantity of supernovae. DOE

N93-16077# Naval Academy, Annapolis, MD.
INVESTIGATION OF A POSSIBLE GALACTIC CHIMNEY Final Report, 1991 - 1992
Bonnie R. Roberts 8 May 1992 77 p
(AD-A257133; USNA-TSPR-196) Avail: CASI HC A05/MF A01

Since the discovery in 1924 that we live in a separate star system, now known as the Milky Way Galaxy, astronomers have worked to understand the structure, composition and dynamics of our galaxy. A particular puzzle in recent years has been the origin and dynamics of the interstellar gas in the halo region of the galaxy high above the visible flat stellar disk. The chimney model dominates current theories of the source, support and ionization of the halo gas, yet no one has actually seen a galactic chimney. The most likely candidate for a galactic chimney in our galaxy was observed. The National Radio Astronomy Observatory telescope and NASA's International Ultraviolet Explorer satellite were used in these observations. The observations provided the data for the study. The investigation take the approach of observing a single region in great detail at many different wavelengths in order to gain understanding of the composition, ionization, and dynamics of the halo gas in the region of a possible galactic chimney. GRA

N93-16101# Los Alamos National Lab., NM.
NEUTRON SUPERFLUID DYNAMICS
Richard I. Epstein, Bennett Link, and Gordon Baym 1992 9 p Presented at the Physics of Isolated Pulsars Workshop, Taos, NM, 23-28 Feb. 1992
(Contract W-7405-eng-36)
(DE92-040386; LA-UR-92-2545; CONF-9202117-4) Avail: CASI HC A02/MF A01

Neutron superfluid dynamics and the coupling between the superfluid and the solid crust play important roles in the rotational, thermal, and magnetic evolution of neutron stars. Here we describe the physical processes by which the neutron superfluid and the crust interact. DOE

N93-16225# Oak Ridge National Lab., TN.
PROSPECTS FOR STUDIES OF ASTROPHYSICAL INTEREST WITH RADIOACTIVE ION BEAMS
J. D. Garrett 1992 10 p Presented at the 2d International Symposium on Nuclear Astrophysics: Nuclei in the Cosmos, Karlsruhe, Germany, 6-10 Jul. 1992
(Contract DE-AC05-84OR-21400)
(DE92-041018; CONF-9207113-2) Avail: CASI HC A02/MF A01

Realistic estimates of the new nuclei that will become accessible for study with the planned new generation of radioactive beam facilities are compared with the predicted paths of the various nucleosynthetic processes. These facilities should permit studies of essentially the complete set of nuclei associated with the rp- and p-processes, the CNL cycle, and big-bang nucleosynthesis, as well as the r-process below A congruent to 150. DOE

N93-16232# Los Alamos National Lab., NM.
ELEMENT DIFFUSION IN PULSATING VARIABLES
J. A. Guzik 1992 10 p Presented at the International Astronomical Union (IAU) Colloquium 139 on New Perspectives on Stellar Pulsation and Pulsating Variable Stars, Victoria, British Columbia, 7-11 Jul. 1992
(Contract W-7405-eng-36)
(DE93-000795; LA-UR-92-2946; CONF-9207156-1) Avail: CASI HC A02/MF A01

Can pulsation studies yield information on the operation of element diffusion in stars? Can diffusion explain unusual properties of pulsating variables? Element diffusion theory and recent research relevant to these questions will be reviewed, with emphasis on the Sun and (delta) Scuti stars. High-degree solar p-modes that are sensitive to helium ionization support a reduced convection zone helium abundance consistent with that expected from diffusion. Intermediate-degree p-modes can be used to probe the structure of the convection zone base and constrain possible diffusion-produced composition gradients. Delta Scuti variables have shallow convection zones and relatively short diffusion timescales. Helium diffusion may explain unusual period ratios, influence period changes, and affect the amplitudes and light curve shapes of delta Scuti stars. DOE

N93-16248# California Univ., Berkeley. Lawrence Berkeley Lab.
INTERPRETATION OF RAPIDLY ROTATING PULSARS
F. Weber (Technische Univ. Munich, Garching, Germany) and N. K. Glendenning Aug. 1992 9 p Presented at the 2nd International Symposium on Nuclear Astrophysics: Nuclei in the Cosmos, Karlsruhe, Germany, 6-10 Jul. 1992
(Contract DE-AC03-76SF-00098)
(DE93-000576; LBL-32562; CONF-9207113-3) Avail: CASI HC A02/MF A01

The minimum possible rotational period of pulsars, which are interpreted as rotating neutron stars, is determined by applying a representative collection of realistic nuclear equations of state. It is found that none of the selected equations of state allows for neutron star rotation at periods below 0.8 to 0.9 ms. Thus, this work strongly supports the suggestion that if pulsars with shorter rotational periods were found, these are likely to be strange-quark-matter stars. The conclusion that the confined hadronic phase of nucleons and nuclei is only metastable would then be almost inescapable, and the plausible ground state in that event is the deconfined phase of (3-flavor) strange-quark-matter. DOE

N93-16362# Chicago Univ., IL. Dept. of Astronomy and Astrophysics.
NUCLEAR PHYSICS AND ASTROPHYSICS
D. N. Schramm and A. V. Olinto Sep. 1992 13 p
(Contract DE-FG02-91ER-40606)
(DE93-002042; DOE/ER-40606/2) Avail: CASI HC A03/MF A01

We have investigated a variety of research topics on the interface of nuclear physics and astrophysics during the past year. We have continued our study of dihyperon states in dense matter and have started to make a connection between their properties in the core of neutron stars with the ongoing experimental searches at Brookhaven National Laboratory. We started to build a scenario for the origin of gamma-ray bursts using the conversion of neutron stars to strange stars close to an active galactic nucleous. We have been reconsidering the constraints due to neutron star cooling rates on the equation of state for high density matter in the light of recent findings which show that the faster direct Urca cooling process is possible for a range of nuclear compositions. We have developed a model for the formation of primordial magnetic fields due to the dynamics of the quark-hadron phase transition. Encouraged by the most recent observational developments, we have investigated the possible origin of the boron and beryllium abundances. We have greatly improved the calculations of the primordial abundances of these elements I greater than y augmenting the reaction networks and by updating the most recent experimental nuclear reaction rates. Our calculations have shown that the

primordial abundances are much higher than previously thought but that the observed abundances cannot be explained by primordial sources alone. We have also studied the origin of the boron and beryllium abundances due to cosmic ray spallation. Finally, we have continued to address the solar neutrino problem by investigating the impact of astrophysical uncertainties on the MSW solution for a full three-family treatment of MSW mixing. DOE

N93-16386# Rome Univ. (Italy). Dipartimento di Fisica.
ARE LARGE QUASAR REDSHIFTS DUE TO LIGHT PROPAGATION IN AN INHOMOGENEOUS AND ANISOTROPIC MEDIUM?
R. Mignani (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 8 Jan. 1991 8 p
(SSCL-Preprint-776; ETN-93-92890) Avail: CASI HC A02/MF A01

A possible interpretation of the large redshifts of quasars is suggested in terms of a generalized Doppler effect. A method based on the Lie isotropic lifting of special relativity is proposed. The generalized Doppler effect obtained within Santilli's Lie isotropic relativity is reviewed. The inhomogeneity and anisotropy of the medium inside quasars is represented by a deformation of the space-time metric, which, in the simplest case, depends on a single parameter b. A generalized expression of the redshift for light propagation in such a medium is obtained. The procedure allows the numerical estimate of b for some quasars associated to galaxies. Some cosmological implications of Santilli's relativity are summarized. ESA

N93-16752*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
THE ATMOSPHERIC STRUCTURES OF THE COMPANION STARS OF ECLIPSING BINARY X RAY SOURCES Final Report
George W. Clark 16 Dec. 1992 51 p
(Grant NAG8-701)
(NASA-CR-191393; NAS 1.26:191393) Avail: CASI HC A04/MF A01

This investigation was aimed at determining structural features of the atmospheres of the massive early-type companion stars of eclipse x-ray pulsars by measurement of the attenuation of the x-ray spectrum during eclipse transitions and in deep eclipse. Several extended visits were made to ISAS in Japan by G. Clark and his graduate student, Jonathan Woo to coordinate the Ginga observations and preliminary data reduction, and to work with the Japanese host scientist, Fumiaki Nagase, in the interpretation of the data. At MIT extensive developments were made in software systems for data interpretation. In particular, a Monte Carlo code was developed for a 3-D simulation of the propagation of x-rays from the neutron star through the ionized atmosphere of the companion. With this code it was possible to determine the spectrum of Compton-scattered x-rays in deep eclipse and to subtract that component from the observed spectra, thereby isolating the software component that is attributable in large measure to x-rays that have been scattered by interstellar grains. This research has culminated in the submission of paper to the Astrophysical Journal on the determination of properties of the atmosphere of QV Nor, the BOI companion of 4U 1538-52, and the properties of interstellar dust grains along the line of sight from the source. The latter results were an unanticipated byproduct of the investigation. Data from Ginga observations of the Magellanic binaries SMC X-1 and LMC X-4 are currently under investigation as the PhD thesis project of Jonathan Woo who anticipated completion in the spring of 1993. Author

N93-16983# Rome Univ. (Italy). Dipt. di Fisica.
ON THE STABILITY OF A STRINGY BLACK HOLE
A. Carlini (SISSA, Trieste, Italy), F. Fucito (Tor Vergata Univ., Rome, Italy), and M. Martellini (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 23 Apr. 1992 16 p
(Preprint-879; ETN-93-92979) Avail: CASI HC A03/MF A01

The stability under perturbations of a charged four dimensional stringy black hole arising from gauging a WZW model is studied. The results show the black hole is stable only in the extremal case Q = M. The purpose of the investigation is to analyze the behavior of a four dimensional black hole under geometrical perturbations. The thermodynamical properties are different for black holes obtained from different investigations. The study of perturbations of stringy black holes in two and four dimensions is performed. The results show that the black hole under study is stable under perturbations of the metric only in the extremal case, supporting the conjecture that extremal black holes might be stable 'quantum' ground state for the underlying theory. ESA

N93-17072# Rome Univ. (Italy). Dipt. di Fisica.
ON THE BLACK-HOLE CONFORMAL FIELD THEORY COUPLED TO THE POLYAKOV'S STRING THEORY. A NON PERTURBATIVE ANALYSIS
M. Martellini (Istituto Nazionale di Fisica Nucleare, Rome, Italy), M. Spreafico (Milan Univ., Italy), and K. Yoshida (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 8 Jan. 1992 7 p
(Preprint-852; ETN-93-92954) Avail: CASI HC A02/MF A01

The aim of the study is to show that coupling the conformal field theory governing the Euclidean two dimensional black hole to D - 1 massless scalar freefields, described by a Polyakov's action with the central charge c (before coupled to the black hole), allows the theory to be also defined in the physical range c = D greater than 1. The original Witten's theory corresponds to the case D = 1. It is shown that the resulting planar string susceptibility is real for any D greater than or equal to zero and less than or equal to 4. ESA

N93-17094# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
X RAY EMISSION FROM ACTIVE GALACTIC NUCLEI AND THE COSMIC X RAY BACKGROUND
Wolfgang Brinkmann, ed. and Joachim Truemper, ed. Mar. 1992 432 p Conference held in Garching, Germany, 4-8 Nov. 1991
(MPE-235; ETN-93-93057) Copyright Avail: CASI HC A19/MF A04

Papers given at a conference to bring together observers and theoreticians for a review of the present state of the subject and to discuss the impacts of first Rosat results are presented. The papers cover all angles of astronomical observation and analysis of X-ray emission data from active galactic nuclei. For individual titles, see N93-17095 through N93-17160.

N93-17095# Leicester Univ. (England). Dept. of Physics and Astronomy.
GINGA AND ROSAT OBSERVATIONS OF THE X RAY SPECTRA OF SEYFERT 1 GALAXIES **c89**
K. A. Pounds, K. Nandra, and G. C. Stewart *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 1-16 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A03/MF A04

New features revealed on the continuum spectra between about 2 to 30 keV as a result of Ginga LAC (Large Area proportional Counter) observations of a large sample of X-Ray bright active galaxies, mainly Seyferts, are discussed. In particular, an emission line (or line complex) near 6.4 keV and a spectral 'hump' above about 10 keV are common properties of the sample, while a number of sources also show evidence for a 'warm' iron K absorption edge. The most likely interpretation of the emission line and hump is by reprocessing of the primary X-ray power law in near neutral (or cold) matter, within the active nucleus and probably associated with the primary accretion process. The depth of the K absorption edge indicates a substantial column density of highly ionized matter in the line of sight to several active galactic nuclei, including some with otherwise 'bare' Seyfert 1 nuclei. Repeated Ginga observations of two 'typical' X-ray bright Seyferts, MCG-6-30-15 and NGC 5548, allowed the variability of the above spectral features to be studied for the first time, providing a direct measure of the geometry and scale of the X-ray reprocessing matter in these objects. Rosat observations are beginning to yield improved definition of the discrete spectral component ('soft excess') often dominant below about 1 keV. ESA

N93-17096# Padua Univ. (Italy). Dipt. di Astronomia.
X RAY LUMINOSITY AND SPECTRAL VARIABILITY OF A COMPLETE SAMPLE OF AGN'S
P. Grandi, G. G. C. Palumbo (Bologna Univ., Italy), G. Tagliaferri (European Space Research Lab., Noordwijk, Netherlands), P. Giommi (European Space Agency. ESRIN, Rome, Italy), and P. Barr (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* MPI fuer Extraterrestrische Physik, X Ray Emission

from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 17-21 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A01/MF A04

One hundred and sixty one Exosat observations of 30 emission line Active Galactic Nuclei (AGN's) in the Piccinotti sample were studied for variability. For each source long (from days to months) and short (from minutes to hours) term luminosity variations were searched for using soft (LE: 0.05 to 2 keV) and long (ME: 1 to 8 keV) light curves. Spectral variability was also investigated for all the 14 objects that showed long time variations in both the energy bands. ESA

N93-17097# Cambridge Univ. (England). Inst. of Astronomy.
OBSERVATIONAL CONSTRAINTS ON AGN MODELS **c89**
A. C. Fabian *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 22-35 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A03/MF A04

The observational constraints placed on the structure and mechanism of the central engine in AGN (Active Galactic Nuclei) are discussed. Particular attention is paid to the results obtained from the X-ray spectra and variability, since they probably originate from innermost regions. Many objects have an efficiency higher than that of nuclear fusion. Together with the lack of soft X-ray absorption in many sources, stellar processes such as massive stars and supernovae can be ruled out. The most plausible model is the accreting black hole. However, definitive evidence for the model is lacking. ESA

N93-17098# Institute of Physical and Chemical Research, Saitama (Japan).
X RAY SPECTRAL STRUCTURE OF SEYFERT GALAXIES
I. A. Bond, M. Matsuoka, and M. Yamauchi *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 36-41 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A02/MF A04

Results of detailed analyses of good statistical data based on Ginga observations (the energy range: 1.5 to 37 keV) are presented. From these results it was established that the overall X-ray spectra of Seyfert galaxies generally rule out a model consisting of a simple power law with uniform absorption plus an iron emission line. Spectra of some Seyfert galaxies (IC4329A, NGC7469, MCG-6-30-15 etc.) are well fitted to the recently favored reflection model, but those of some other Seyfert galaxies (NGC4151, NGC6814, NGC5506 etc.) rule out this model. The spectra of NGC4151 and NGC6814 are well fitted to a partial covering model. On the other hand softness variability of NGC5506 can be modeled either by partial covering of the hard X-ray source or as thermal bremstrahlung emission. The spectrum of this source also shows the signatures of cold thick matter near the central engine characteristic by an iron fluorescence line at 6.4 keV and a hard tail attributed to Compton reflection of X-ray source by the cold matter. This composite feature would be a general model for X-ray spectra of Seyfert galaxies. ESA

N93-17099# Tuebingen Univ. (Germany). Astronomisches Inst.
RECENT RESULTS ON 3C 273
R. Staubert *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 42-49 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A02/MF A04

Recent results on 3C 273, one of the nearest and brightest quasars at high photon energies from observations with Rosat, Ginga, (Japanese X-ray satellite), High Energy X-ray Experiment (HEXE), Gamma Ray Observatory (GRO) and ground based instruments are discussed. Two Rosat observations clearly establish a time variable 'soft excess' spectral component, the second observation being simultaneous with Ginga allows construction of a combined spectrum from 0.1 keV to 20 keV; a combined HEXE/Ginga spectrum (1.5 to 150 keV) constrains 'pairs and reflection'; multifrequency observations in Jun./Jul. 1991, including data from GRO, will provide a 'snapshot' spectrum from radio frequencies to high energy gamma rays. ESA

N93-17100# Centre d'Essais de Propulseurs, Saclay (France). Centre d'Etudes Nucleaires.
HARD X RAY OBSERVATIONS OF ACTIVE GALACTIC NUCLEI WITH SIGMA **c89**
J. Ballet, F. Lebrun, J. Paul, A. Claret, E. Jourdain (Centre d'Etude Spatiale des Rayonnements, Toulouse, France), L. Bassani (Centre d'Etude Spatiale des Rayonnements, Toulouse, France), L. Bouchet (Centre d'Etude Spatiale des Rayonnements, Toulouse, France), P. Mandrou (Centre d'Etude Spatiale des Rayonnements, Toulouse, France), R. Sunyaev (Academy of Sciences, USSR, Moscow), and E. Churazov (Academy of Sciences, USSR, Moscow) et al *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 50-53 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A01/MF A04

Variations of the sources observed with the French Sigma telescope are reported including data obtained in June and July 1991. At the sensitivity level for single sessions, only strong variations could be clearly detected. Flux variations of Cen A, NGC 4151 and of 3C 273 observed by Sigma are presented. ESA

N93-17101# Warsaw Univ. (Poland). N. Copernicus Astronomical Center.
CHAOTIC BEHAVIOUR OF X RAY LIGHTCURVES OF AGN?
B. Czerny, H. Lehto (Southampton Univ., England), and I. McHardy (Southampton Univ., England) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 54-57 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A01/MF A04

The correlation integral method was used to analyze eight Exosat long X-ray light curves of seven Active Galactic Nuclei (AGN) and to put some constraints on the theoretical model in a model independent way. The character of variability was studied by comparing the shapes of light curve fragments created by d succeeding observational points. The computations proceed for d = 1, 2, 3 ... until the result saturates and the increase of the length of sequences does not include any new information; this means that the system has got no more degrees of freedom. The analysis of NGC 4051 (LE) indicated that deterministic chaos is responsible for variability of this source. It does not necessarily mean that this AGN has a different structure than other studied sources as it is a factor 100 fainter and the sampling frequency in Exosat data may be adequate only for NGC 4051. ESA

N93-17102# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
FIRST RESULTS FROM THE COMPTON OBSERVATORY
Corinna vonMontigny *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 58-61 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A01/MF A04

The first observations of Active Galactic Nuclei (AGN) with the Comptel (Compton Telescope) and Egret (a spark chamber experiment) instruments aboard the Compton Gamma Ray Observatory are reviewed. Comptel detected the quasar 3C 273 in the energy range from 1 MeV to 30 MeV. A new discovery in the energy range greater than 30 MeV is the detection of the optically violent variable quasar 3C 279 by Egeret. Although 3C 279 is a very strong source in the 0.5 to 50 GeV range it is not strong in the 1 to 30 MeV band. Jet models which include gama to gamma attenuation are possibly able to represent the observed data. ESA

N93-17103# Danish Space Research Inst., Lyngby.
OBSERVING AGN AND DXRB WITH XSPECT/SODART **c89**
Niels Joergen Westergaard and Hans Ulrik Noergaard-Nielsen *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 62-65 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A01/MF A04

Properties of the Xspect high and low energy proportional counters and the Silicon X-Ray Array (SIXA) solid state pixel detector, part of the Xspect/Sodart experiment on Spectrum X-Gamma mission to be launched late in 1994 are considered. Typical Xspect Active Galactic Nuclei (AGN) observations were simulated. The capabilities of the Xspect telescopes for

obtaining detailed spectra of faint sources as expressed by detection in an energy interval of 1 keV at 2 and 8 keV respectively are discussed. Xspect is compared with Jet-X, the other main telescope on Spectrum X-Gamma. It is seen that Xspect runs into confusion problems long before Jet-X at low energies, whereas confusion is not a problem at high energies even for an observing time of 1 day. The comparison is made for various broader energy intervals. Again confusion is only a problem for Xspect at the lowest energies. The capacity of Xspect for obtaining the spectrum of DXRB is demonstrated. It was found that good spectra can be obtained for AGN at 25 percent of the Einstein deep survey limit and that the spectrum of the Diffuse X-Ray Background (DXRB) can be measured up to about 9 keV. ESA

N93-17104*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

CORRELATED HARD X RAY AND UV VARIABILITY IN NGC 5548 c89

J. Clavel (European Space Research Lab., Noordwijk, Netherlands), K. Nandra (Leicester Univ., England), F. Makino (Tokyo Univ., Sagamihara, Japan), K. A. Pounds (Leicester Univ., England), G. A. Reichert, C. M. Urry (Space Telescope Science Inst., Baltimore, MD.), W. Wamsteker (European Space Agency. ESA Tracking Station, Madrid, Spain), M. Peracaula-Bosch, and G. C. Stewart (Leicester Univ., England) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 66-73 (For primary document see N93-17094 05-90)

Copyright Avail: CASI HC A02/MF A04

Observations of the nucleus of NGC5548 made at 11 different epochs during May - July 1990, in low resolution mode (1000 km/s) and through large apertures (10 by 20 inches) of the International Ultraviolet Explorer (IUE) spectrographs, are discussed. The patterns of variability are considered. Figures showing the following are given: light curves of the continuum in the X-ray and UV bands, together with the light curves of the strongest emission lines; the 2 to 10 KeV X-ray flux as a function of the 1350 A continuum for the 11 epochs of simultaneous X-ray and UV observations; the cross correlation and discrete correlation of F (sub 2 to 10) with F(sub 1350). Implications of the findings are discussed. ESA

N93-17105# Kyoto Univ. (Japan). Dept. of Physics.

GINGA RESULTS OF TYPE 2 AGN'S AND THEIR CONTRIBUTIONS TO THE COSMIC X RAY BACKGROUND c93

Katsuji Koyama *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 74-80 (For primary document see N93-17094 05-90)

Copyright Avail: CASI HC A02/MF A04

X-ray emission from type 2 Active Galactic Nuclei (AGN) are studied with the Ginga satellite. Many of the sample of optically selected Seyfert 2s show low energy cutoffs, while some of them show reflected components. Some narrow line radio galaxies are found to have obscured nuclei. Thus, so called unified model of the active galactic nuclei is supported by the analysis of the X-ray spectrum. However the Infrared Astronomical Satellite (IRAS) selected Seyfert 2 galaxies show different phenomena. An origin of the cosmic X-ray background is discussed based on the unified picture of the AGN. ESA

N93-17106*# Seattle Univ., WA. Dept. of Astronomy.

THE X RAY PROPERTIES OF A LARGE, UNIFORM QSO SAMPLE: EINSTEIN OBSERVATIONS OF THE LBQS c89

B. Margon, S. F. Anderson, X. Xu, P. J. Green, and C. B. Foltz (Arizona Univ., Tucson.) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 81-84 (For primary document see N93-17094 05-90)

(Grants NAG5-1254; NAG8-590; NAG5-1253)

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Although there are large numbers of Quasi Stellar Objects (QSO's) now observed in X rays, extensive X-ray observations of uniformly selected, 'complete' QSO samples are more rare. The Large Bright QSO Survey (LBQS) consists of about 1000 objects with well understood properties, most brighter than B = 18.8 and thus amenable to X-ray detections in relatively brief exposures. The sample is thought to be highly complete in the range 0.2 less than z less than 3.3, a significantly broader interval than many other surveys. The Einstein IPC observed 150 of these objects, mostly serendipitously, during its lifetime. We report the results of an analysis of these IPC data, considering not only the 20 percent of the objects we find to have positive X-ray detections, but also the ensemble X-ray properties derived by 'image stacking'. ESA

N93-17107*# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.

EXTRAGALACTIC COUNTERPARTS TO EINSTEIN SLEW SURVEY SOURCES c89

Jonathan F. Schachter, Martin Elvis, David Plummer, and Ron Remillard (Massachusetts Inst. of Tech., Cambridge.) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 85-90 (For primary document see N93-17094 05-90)

(Grant NAG5-1746)

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The Einstein slew survey consists of 819 bright X-ray sources, of which 636 (or 78 percent) are identified with counterparts in standard catalogs. The importance of bright X-ray surveys is stressed, and the slew survey is compared to the Rosat all sky survey. Statistical techniques for minimizing confusion in arcminute error circles in digitized data are discussed. The 238 slew survey active galactic nuclei, clusters, and BL Lacertae objects identified to date and their implications for logN-logS and source evolution studies are described. ESA

N93-17108# London Univ. (England). Dept. of Physics.

POWER SPECTRUM MODELLING OF THE X RAY VARIABILITY OF NGC4051

I. E. Papadakis and A. Lawrence *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 91-96 (For primary document see N93-17094 05-90)

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A new power spectrum analysis of the Exosat soft (LE) and hard (ME) data of NGC 4051 was performed which enabled a chi squared model fitting technique to be used to fit different mathematical models to the resulting power spectra. Evidence for significant structure was found and the power spectra of the soft and hard components appear to be significantly different. ESA

N93-17109# Landessternwarte auf dem Koenigstuhl, Heidelberg (Germany).

MULTIFREQUENCY OBSERVATIONS OF RAPIDLY VARIABLE BLAZARS c89

Stefan J. Wagner *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 97-102 Sponsored by Sonderforschungsbereich 328 (For primary document see N93-17094 05-90)

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Campaigns, carried out simultaneously in several frequency bands aimed at a densely sampled monitoring of the variability pattern of the BL Lac object 0716+714, are reported. The variations are closely correlated both in simultaneous radio optical as well as optical X-ray observations. The time lag between variations at different wavelengths is difficult to assess due to the quasi periodic nature of the variations but is likely to be smaller than a few days. The time lags and the statistically asymmetric light curves argue against the variations being caused by the microlensing effect. It is speculated that the emission process of the rapidly variable component is different from the classical SSC model, possibly due to coherent radiation mechanisms as caused by anisotropic electron distributions. ESA

N93-17110# Stockholm Observatory (Sweden).

AN INTRODUCTION TO THE PAIR-REFLECTION MODEL OF X-RAY SPECTRA IN AGN'S

Roland Svensson *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 103-116 (For primary document see N93-17094 05-90)

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The pair reflection model of Zdziarski, Ghisellini, George, Svensson, Fabian, and Done (1990), in which most features of the extreme ultraviolet gamma ray spectra of Active Galactic Nuclei (AGN) are accounted for is considered. Details of the conception of the model are given and the

model itself is explained. In the pair reflection model a pair cloud located above a cold slab generates a self consistently computed nonthermal spectrum that irradiates and is reflected by the slab. Some of these features are discussed using simplest possible arguments. The robustness of the pair reflection model as well as possible variability patterns are also discussed. ESA

N93-17111# Cambridge Univ. (England). Inst. of Astronomy.
THE SPECTRA OF ACCRETION DISCS IN ACTIVE GALACTIC NUCLEI
R. R. Ross (College of the Holy Cross, Worcester, MA.), A. C. Fabian, and S. Mineshige (Ibaraki Univ., Mito, Japan) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 117-122 (For primary document see N93-17094 05-90)
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Fully self consistent calculations of the spectra emitted by active galactic nuclei accretion disks are presented. The inner, radiation dominated regions of standard, alpha disks are treated. Incoherent Compton scattering and emission/absorption of radiation by hydrogen and helium are included in computing the vertical temperature structure within the disk and the emergent spectrum. At high accretion rates (L approximately L (sub edd)) comptonization modifies the extreme ultraviolet/soft X-ray continuum and the He2 spectral features. In particular, an important fraction of the emergent flux appears in the form of a steep soft X-ray spectrum. ESA

N93-17112# Hebrew Univ. of Jerusalem, Rehovot (Israel).
EVOLUTIONARY HYBRID ACCRETION DISC MODELS OF AGN AND THE ROSAT COSMIC X RAY BACKGROUND **c93**
Amri Wandel (Weizmann Inst. of Science, Rehovoth, Israel) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 123-129 (For primary document see N93-17094 05-90)
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Two new elements, the Hybrid Accretion Disk (HAD) model and the Rosat survey of resolved X-ray sources and diffuse background, are combined in an attempt to resolve the long standing problem of the cosmic X-Ray Background (XRB), explaining the diffuse XRB as the integrated radiation of unresolved early quasars and Active Galactic Nuclei (AGN). It is suggested that a large fraction of the soft and hard XRB is produced by early AGN with intrinsic spectra different from low redshift AGN. When redshifted from z = 3 to 5 the HAD spectrum yields the two major features of the XRB: the flat bremsstrahlung spectrum at a few tens keV, and the soft X-ray power law discovered by Rosat. It is demonstrated that emission from HAD's in AGN can explain the XRB spectrum over the entire range from soft X-rays to gamma rays. ESA

N93-17113# Tuebingen Univ. (Germany). Astronomisches Inst.
UV TO X RAY AGN ACCRETION DISC SPECTRA: MODEL FITTING OF IUE AND ROSAT ALL SKY SURVEY DATA
Thomas Doerrer, Peter Friedrich, Hermann Brunner, Ruediger Staubert, Volker Pussel, Harald Riffert, and Hanns Ruder *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 130-133 (For primary document see N93-17094 05-90)
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Big blue bump accretion disk spectra are presented for a sample of radio loud and radio quiet quasars, comprising IUE (International Ultraviolet Explorer) and Rosat All Sky Survey (RASS) data. These data are fitted to geometrically thin alpha accretion disk spectra, attempting to restrict the permitted range of the model parameters: central mass, accretion rate, alpha viscosity parameter and inclination angle of the accretion disk. The accretion disk structure is calculated. The local accretion disk continua are determined. The integrated accretion disk spectra are corrected for Doppler shifting due to the rotation of the accretion disk and gravitational red shift and light deflection due to gravitational field of the central black hole. Mass accretion rates are found in the range form 0.2 to 1.2 times M(sub Edd). Only in some of the sources the accretion disk component is hard enough to produce a measurable soft X-ray flux. The fits require a steep (alpha(sub energy) approximately 1 to 1.5) underlying power law component consistent with the optical to X-ray broad band power law index alpha(sub ox) and the X-ray power law indexes as measured by the Rosat Position Sensitive Proportional Counter (PSPC). ESA

N93-17114# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany).
X AND GAMMA RAY FLARING OF 3C279 AND THE BARYONIC COMPONENT OF NONTHERMAL PARTICLE DISTRIBUTIONS IN RADIOJETS
Karl Mannheim and Peter L. Biermann *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 134-137 (For primary document see N93-17094 05-90)
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A conservative explanation of the superluminal flat spectrum radio source 3C279, for which flare like activity has been reported from the radio to the gamma ray regime, is presented. The explanation is based upon the theory of diffusive shock acceleration of electronics and protons and analytic treatment of the coupled transport equations for proton secondary particles (photons, electrons, positrons). The salient feature of the resulting physical picture of the emission during outbursts is that the electrons produce synchrotron continuum emission below and the protons initiate an electromagnetic cascade dominating X and gamma ray emission. Rosat observations are thus important and reasons for this are addressed. ESA

N93-17115# Special Astrophysical Observatory, Nishnyi Archys (USSR).
THE NONTHERMAL MODEL OF DISC ACCRETION ONTO A MAGNETOSPHERE
N. R. Ikhsanov (Central Astronomical Observatory, Saint Petersburg, Russia) and L. A. Pustilnik *In* MPI fuer Extraterrestrische Physik, X-Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 138-142 (For primary document see N93-17094 05-90)
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The whole process of disk accretion onto a magnetosphere is considered and a model to illustrate this is presented. An illustrative model of the high conductive accretion disc drawing the lines of force of the outer magnetosphere and flowing around the inner magnetosphere by force is presented. A further diagram illustrates the polar cone with central magnetic tube. The plasma vortex is a source of thermal X-rays and d layer is a source of ultra high energy particles and nonthermal radiation. It is concluded that the compact object gravitational energy is converted to the energy of toroidal magnetic field of the diffusion layer. The amount of nonthermal processes to the total energy is, in this case, determined by the efficiency of tearing mode. Using the analogy with solar flares and plasma experiments it can be expected that current layers of the polar vortex are the powerful source of accelerated particles and nonthermal radiation comparable (or exceeding) in efficiency with radiation losses of thermal plasma in alpha cone. ESA

N93-17116# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
ROSAT OBSERVATIONS OF AGN **c89**
Wolfgang Brinkmann *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 143-154 Sponsored by BMFT (For primary document see N93-17094 05-90)
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New aspects for the study of Active Galactic Nuclei (AGN) opened up as a result of the Rosat mission are reviewed: the soft energy range of the X-Ray Telescope (XRT) combined with the good energy resolution of the Position Sensitive Proportional Counter (PSPC) detector allows an investigation of the spectral properties of the sources in this energetically vital band. The unprecedented high sensitivity of the instrument in the all sky survey yielded an enormous number of previously unknown X-ray AGN for the statistical and morphological exploration of these objects. The AGN observed with Rosat can be grouped quite naturally into three classes, where the number of objects increases by roughly a factor of ten in each class. The first class consists mainly of previously well known, bright 'classical' AGN extensively studied at medium X-ray energies and at other wavelengths. The second class of objects was already known as AGN from optical work but without previous X-ray detections, and in the last class are objects detected for the first time through their X-ray emission. A certain fraction of them has been cataloged previously for example in radio surveys, but their nature remains uncertain. Results from all three of these classes, as they are available at the time of writing with about 90percent of the survey data processed, are discussed. ESA

N93-17117*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

ROSAT-IUE ALL SKY SURVEY (RIASS): FIRST RESULTS ON ACTIVE GALAXIES

W. Wamsteker (European Space Agency. ESA Tracking Station, Madrid, Spain), D. deMartino (European Space Agency. ESA Tracking Station, Madrid, Spain), P. RodriquezPascual (European Space Agency. ESA Tracking Station, Madrid, Spain), J. Truemper (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), J. M. Mas-Hesse (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), K. A. Pounds (Leicester Univ., England), K. Nandra (Leicester Univ., England), F. Makino (Tokyo Univ., Sagamihara, Japan), and J. M. Bonnell et al *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 155-162 (For primary document see N93-17094 05-90)
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To optimize the activity of the RIASS collaboration was established between IUE and Rosat projects. Some of the results obtained are given and the importance of such coordinated observations for the Spectral Energy Distribution (SED) definition of Active Galactic Nuclei is illustrated. All the participants in the AGN part of the RIASS program are listed. The RIASS observations allow for a comprehensive study of the overall spectral energy distribution of AGN's. For the first time, data from different instruments can be used to determine the SED, since the observations were simultaneous. A preliminary analysis shows that the energies radiated in the UV and the soft X-rays domains are closely related. The spectra of individual objects as well as the correlation found between the intensity of CIV lambda 1550 emission line and the soft X-rays luminosity, suggest that the excess detected in this band is the high energy tail of the big UV bump. ESA

N93-17118# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany).

MULTIFREQUENCY OBSERVATIONS OF ROSAT SELECTED RADIO SOURCES **c89**

M. Neumann, W. Reich, E. Fuerst, W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), P. Reich, R. Wielebinski, H. H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), and J. Truemper (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 163-168 (For primary document see N93-17094 05-90)
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A status report and first results on multifrequency radio continuum observations with the Effelsberg 100 m telescope of radio sources which have counterparts in the Rosat all sky survey are given. Up to now more than 200 sources have been observed at 21, 11, 6 and 2.8 cm wavelength in the flux density range above 20 mJy. From these observations the spectrum, size, linear polarization and improved positions of these sources were determined. A comparison of the more precise radio positions with the Rosat positions indicates a systematic difference of about 20 inches. The statistical properties of the Rosat selected radio sources are given and compared with results from unbiased source surveys so far available. In general the differences are small. A weak excess of flat spectrum sources and a higher fraction of unresolved sources is found. Cumulative counts of the radio sources, however, show an increasing deficit of weak sources. At 11 cm wavelength there are about three times less sources at 100 mJy than expected and this deficit increases to more than a factor of 10 at a level of 30 mJy. The cumulative counts of the X-ray sources from the Rosat survey indicate a deficit of sources below 10 to the minus 12th power erg/sq cm.s. No global correlation between radio flux densities and X-ray flux densities was found. The sample of sources is at present not large enough to establish any possible correlation for distinct groups of radio sources with common properties. ESA

N93-17119# European Space Agency, Garching (Germany).

THE QUASAR 1821+643 DURING THE ROSAT SURVEY **c89**

M.-H. Ulrich, H. H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), S. Schaeidt (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), M. Kolman (Columbia Univ., New York, NY.), M. A. Malkan (California Univ., Los Angeles.), L. Maraschi (Milan Univ., Italy), A. Treves (Milan Univ., Italy), and S. Wagner (Landessternwarte auf dem Koenigstuhl, Heidelberg, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 169-174 (For primary document see N93-17094 05-90)
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Observations of the nearby intrinsically bright quasar 1821 + 643 situated at 86 deg. ecliptic latitude, for 37 days by the X-ray Telescope/Position Sensitive Proportional Counter (XRT/PSPC) during the Rosat all sky survey and with IUE on 7 days almost evenly spaced during Rosat visibility period are reported. Both the X-ray and the UV flux remained constant within the measurement errors during that period. The spectrum obtained by adding all the photons can be well fitted with a model comprising a power law with Gamma approximately -1.80, N(sub H) fixed to the galactic value of 4.09 times 10 to the 20th power/sq cm and a soft excess component. From a statistical viewpoint the fits of the soft excess by a black body, by a thermal bremsstrahlung or by a step power law are equally acceptable. ESA

N93-17120# SISSA, Trieste (Italy).

MULTIFREQUENCY OBSERVATIONS OF KAZ 102 DURING ROSAT ALL SKY SURVEY **c89**

A. Treves, H. H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), M. Malkan (California Univ., Los Angeles.), L. Maraschi (Milan Univ., Italy), M. H. Ulrich (European Space Agency, Garching, Germany), W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), D. deMartino (European Space Agency. ESA Tracking Station, Madrid, Spain), M. Elvis (Smithsonian Astrophysical Observatory, Cambridge, MA.), J. Heidt (Landessternwarte auf dem Koenigstuhl, Heidelberg, Germany), and J. McDowell (Smithsonian Astrophysical Observatory, Cambridge, MA.) et al *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 175-180 (For primary document see N93-17094 05-90)
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Results of X-ray observations, ultraviolet observations with the IUE camera, and optical photometry observations carried out with a 70 cm telescope, of Kaz 102, a close by radio quiet quasar, are presented. Optical and UV observations indicated that during the X-ray monitoring the source exhibited variability of 10 percent. Comments on the X-ray variability were not made due to systematic errors. It was hoped to be able to correlate the UV and optical photometry when all the optical data of the collaboration would be analyzed, the perspective of a cross correlation with X-rays are not good, because optical data indicated a modest variability. If the X-ray variability is similar, it is doubted that systematic errors could be reduced in such a way that the variability can show up. The X-ray spectrum indicates some soft excess, which is not unexpected in the PSPC (Position Sensitive Proportional Counter) energy range. Results are compared with the Einstein 1979 data. ESA

N93-17121# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

ROSAT AND MULTI-WAVELENGTH OBSERVATIONS OF 3C 371 **c89**

H. H. Fink, M. Malkan (California Univ., Los Angeles.), A. Treves (SISSA, Trieste, Italy), M.-H. Ulrich (European Space Agency, Garching, Germany), L. Maraschi (Milan Univ., Italy), S. Schaeidt, F. Baganoff (California Univ., Los Angeles.), W. Brinkmann, G. Hartner, and L. Morbidelli (Consiglio Nazionale delle Ricerche, Florence, Italy) et al *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 181-186 (For primary document see N93-17094 05-90)
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Multiwavelength monitoring of the BL Lacertae object 3C 371 centered on the extended X-ray observation during the Rosat all sky survey in Aug. and Sep. 1990 is reported. Significant variations in the X-ray, UV, and optical fluxes were detected, the amplitude and rapidity of which decreased at longer wavelengths. The X-rays flared on Aug. 28 for about a day and showed a gradual rise in flux towards the end of the observation. This flux increase was also found in the UV. The steep X-ray spectrum is well described by a power law model with galactic low energy absorption modified by an absorption line below 1 keV. The photon index was determined to be Gamma = 2.66 +/- 0.09. Compared with a previously measured overall energy distribution of 3C 371, the optical to X-ray spectrum was found to

be fainter and steeper with diminishing declines at increasing wavelengths. The radio to infrared spectrum, however, remained unchanged for more than 9 years. ESA

N93-17122*# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
A DEEP ROSAT OBSERVATION OF THE HIGHLY VARIABLE AGN 1E1403+5439 OR ROSAT NON-DETECTION OF THE WEAK AGN 1E1403+5439 **c89**
T. Belloni and S. L. Snowden (Wisconsin Univ., Madison.) *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 187-190 (For primary document see N93-17094 05-90)
(Grant NAG5-1438)
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A long (33600 s) Rosat Position Sensitive Proportional Counter observation of the galaxy M101 was performed. The field includes the serendipitous Einstein source 1E1403 + 5439, which was previously observed to vary by a factor 5.5 in 160 days. Despite the higher sensitivity of the Rosat PSPC and the high exposure time, the source could not be detected down to a much lower flux limit than the lowest Einstein detection. The unusually high variability and the proximity (18 feet) to M101 make this source a good candidate for gravitational microlensing. ESA

N93-17123# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
TIME VARIABILITY OF EXTRAGALACTIC SOURCES IN THE ECLIPTIC POLE REGIONS
S. Schaeidt, G. Hasinger, and J. Truemper *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 191-194 (For primary document see N93-17094 05-90)
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A report on a search for time variability of Active Galactic Nuclei (AGN) detected during the Rosat all sky survey in the north and south ecliptic polar regions is given. The time coverage ranges from 6 months within 1 deg around the poles to 12 days at 10 deg off the poles. The present analysis is based on 118 days (approximately 65 of the total observation time) and includes the brightest 64 sources with 13 deg from the two poles. 40 of these could be identified, the majority are bright large magellanic clouds objects and coronal stars and also 5 AGN. Preliminary results of time variability analysis are presented in particular the light curves of two very strongly variable, as yet unidentified sources. ESA

N93-17124# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
A COMPARATIVE STUDY OF SOFT X RAY QSO SPECTRA **c89**
N. Schartel, H. Fink, W. Brinkmann, and J. Truemper *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 195-197 (For primary document see N93-17094 05-90)
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A method developed to estimate spectral parameters from hardness ratios and thus to be used to study the spectral properties of a large sample of Quasi-Stellar Objects (QSO) detected in the Rosat all sky survey, is presented. The slopes of quasar spectra with low intrinsic absorption were considered as a function of the quasar redshifts. A flattening of the spectral index with increasing redshift was found and interpreted as steepening of the intrinsic spectra towards the soft X-ray region. ESA

N93-17125# Tuebingen Univ. (Germany). Astronomisches Inst.
SPECTRA OF RADIO-LOUD QUASARS OBSERVED IN THE ROSAT/XRT ALL SKY SURVEY **c89**
Hermann Brunner, Peter Friedrich, Hans-Ulrich Zimmermann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), and Ruediger Staubert *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 198-201 (For primary document see N93-17094 05-90)
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The X-ray and broadband spectrum properties of a flux limited sample of radio loud quasars observed in the Rosat All Sky Survey (RASS) were investigated. Mean X-ray spectral indexes of alpha(sub energy) approximately 1.1 were found in the flat radio spectrum subsample and approximately 1.3 in the steep radio spectrum subsample. This is harder than the mean X-ray spectra for radio quiet quasars (alpha (sub energy) approximately 1.5) observed in the RASS but considerably steeper than the mean X-ray spectral index observed for radio loud quasars in the Einstein Image Proportional Counter (IPC). There is a strong correlation between the X-ray power law index observed in the RASS and the optical to X-ray broad band power law index alpha(sub ox), consistent with the two being identical in the flat radio spectrum sample. This was interpreted as evidence for a power law component extending all the way from the optical to the soft X-ray range which was not seen in former X-ray missions. A hardening was also found of the X-ray spectra with redshift and/or X-ray luminosity in the flat radio spectrum sample, possibly due to fact that the steep spectral component observed at low redshifts out of the Rosat energy range. ESA

N93-17126# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
X RAY SPECTRA OF BRIGHT BL LACERTAE OBJECTS OBSERVED WITH ROSAT **c89**
H. H. Fink, H.-C. Thomas (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), W. Brinkmann, R. Okayasu (Institute of Physical and Chemical Research, Saitama, Japan), and G. Hartner *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 202-205 (For primary document see N93-17094 05-90)
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The soft X-ray data of 10 bright BL Lacertae objects observed during the Rosat All Sky Survey (RASS) were analyzed in order to compare their spectral characteristics. The spectra are well described by simple power law models. No indications for intrinsic absorption were found. The steep spectral indices of all spectra are very similar. In the spectra of three BL Lacertae absorption features below 1 keV, although statistically insignificant, cannot be excluded. ESA

N93-17127# SISSA, Trieste (Italy).
PRELIMINARY RESULTS ON ROSAT OBSERVATIONS OF THE BLAZAR PKS 0537-441 **c89**
A. Treves, T. Belloni (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), R. Falomo (Osservatorio Astronomico, Padova, Italy), H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), L. Maraschi (Milan Univ., Italy), and H. U. Zimmermann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany) *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 206-209 (For primary document see N93-17094 05-90)
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PKS 0537-447, an object with properties intermediate between BL Lacs and optically violently variable and highly polarized quasars, was observed with Rosat in Apr. 1991. The X-ray flux F(1 keV) = 0.79 +/- 0.05 mu-Jy is higher than those detected by the Einstein observatory (1979-80), and Exosat (1985), while the spectral slope alpha(sub ph) = 2.1 +/- 0.4 is steeper. The hydrogen column density N(sub H) = 3.0 +/- 1.3 times 10 to the 20th power/sq cm is consistent with that deduced from 21 cm observations. ESA

N93-17128# Cambridge Univ. (England). Center for Astrophysics.
ROSAT X RAY SPECTRA OF QUASARS WITH A RANGE OF CONTINUUM PROPERTIES AND REDSHIFT **c89**
Belinda J. Wilkes, Martin S. Elvis, Harvey Tananbaum, Jonathan C. McDowell, and Andrew Lawrence (London Univ., England) *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 210-215 (For primary document see N93-17094 05-90)
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Soft x-ray spectral observations of three targeted and two serendipitous quasars with the Rosat Position Sensitive Proportional Counter (PSPC) are reported. These quasars were observed as part of a program to observe objects covering the full range of the quasar population to study the range and evolution of their x-ray spectra and eventually their full wavelength distributions. The inital sample included three radio loud, all with z greater than 0.5 and two low redshift, radio quiet quasars, one with a known excess from Einstein observations. The highest redshift object (PKS0438-43, z = 2.85) is the first high luminosity quasar to show a significant absorbing column in excess of the Galactic value and calls into question the inverse

absorption/luminosity correlation found at low redshift. Only two of the three radio loud quasars follow the Einstein observed correlation between x-ray slope and core dominance parameter. ESA

N93-17129# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
PRELIMINARY RESULTS ON THE PROPERTIES OF THE EMSS AGN'S AS DERIVED FROM THE ROSAT ALL SKY SURVEY **c89**
S. Molendi (Milan Univ., Italy), W. Brinkmann, and T. Maccacaro (Osservatorio Astronomico, Brera, Milan, Italy) *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 216-219 (For primary document see N93-17094 05-90)
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Results on Einstein Medium Sensitivity Survey (EMS) Active Galactic Nuclei (AGN) for the first approximately 90 percent of the Rosat All Sky Survey (RASS) are presented. Of the 427 AGN's in the EMSS, approximately 31 percent were detected in the RASS, for another approximately 36 percent upper limits are available, while, so far, no useful information is available for the remaining 33 percent. The average photon index of the EMSS AGN's in the position sensitive proportional counter band (01.1 to 2.4 keV), as determined from the hardness ratios, is significantly steeper than the one determined from Image Proportional Counter (IPC) data on the (0.3 to 3.5 keV) band for the same set of sources. The comparison of Rosat fluxes computed from count rates in the B band (0.4 to 2.4 keV) to fluxes in the EMSS band (0.3 to 3.5 keV) together with the spectral indices analysis indicates that sources tend to be steeper when they are brighter. ESA

N93-17130# Tuebingen Univ. (Germany). Astronomisches Inst.
SOURCE CONTENT OF A DEEP POINTED ROSAT OBSERVATION AT VERY LOW N(SUB H) **c89**
Georg Lamer, Ruediger Staubert, and Hermann Brunner *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 220-223 (For primary document see N93-17094 05-90)
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Thirty five x-ray sources were detected in a 6.4 ksec Rosat Position Sensitive Proportional Counter (PSPC) exposure pointed at the quasar PKS 0135-247. The field lies at high galactic latitude with galactic N(sub H) of 1.4 times 10 to the 20th power/sq cm. Twenty six serendipitous sources were detected with a significance greater than 5 sigma. An attempt was made to identify these sources with entries of optical, radio, and x-ray catalog and to search for optical counterparts in the ESO R and SRC J plates. X-ray spectral slopes and f(sub x)/f(sub opt) values were calculated from detected count rates and hardness ratios. Spectral fits of the five brightness sources could be obtained. ESA

N93-17131# Birmingham Univ. (England). School of Physics and Space Research.
PRELIMINARY RESULTS FROM THE ROSAT WFC ALL SKY SURVEY: A SAMPLE OF LOW GALACTIC COLUMN DENSITY AGN'S **c89**
Monika Balucinska-Church and P. Gondhalekar (Rutherford Appleton Lab., Chilton, England) *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 224-226 (For primary document see N93-17094 05-90)
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Rosat Wide Field Camera (WFC) observations of five Active Galactic Nuclei (AGN), with very low column densities, were analyzed. These observations were made during the Rosat all sky survey. Positive detections were made only for 3C 273 and NGC 5548 and in both cases the results are consistent with the existence of a soft excess. The analysis of the WFC images was carried out using a point source searching program. Images were obtained for each of the five sources with the known position of the source at the center of the image. This allowed optimum subtraction of the background. These images were searched for significant peaks within 1 arc min of the source position and during the search procedure the background subtraction was finely tuned. Positions of the detected peaks were boresight corrected. The results of the analysis are shown. The following parameters are listed: the significance of the detection, the WFC count rate, and its 1 sigma error. ESA

N93-17132*# Washington Univ., Seattle.
INITIAL RESULTS FROM A ROSAT DEEP SURVEY IN LYNX **c89**
S. F. Anderson, R. A. Windhorst (Arizona State Univ., Tempe.), T. Maccacaro (Osservatorio Astronomico, Brera, Milan, Italy), D. Burstein (Arizona State Univ., Tempe.), B. E. Franklin (Arizona State Univ., Tempe.), R. E. Griffiths (Space Telescope Science Inst., Baltimore, MD.), D. C. Koo (Lick Observatory, Santa Cruz, CA.), D. F. Mathis (Arizona State Univ., Tempe.), W. A. Morgan (Pennsylvania State Univ., University Park.), and L. W. Neuschaefer (Arizona State Univ., Tempe.) *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 227-230 Sponsored in part by Alfred P. Sloan Foundation (For primary document see N93-17094 05-90)
(Grants NAG5-1623; NAG5-1630; NAG1-455; NSF AST-88-21016)
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Preliminary results from a deep (70 ksec) Rosat survey of the high galactic latitude selected area Lynx.3A are presented. Lynx.3A sensitivity was previously studied in both the optical radio, with deep Westerbork surveys and deep multicolor Charge Couple Device (CCD) images form the Palomar 200 inch Four-Shooter. About 70 x-ray sources were detected within the central 40 foot diameter region of the Position Sensitive Proportional Counter (PSPC), observed surface densities of approximately 200 x-ray sources/sq deg are suggested, and these x-ray sources alone account for approximately 30 percent of the cosmic x-ray background (0.9 to 2.2 keV). An initial look at the observed x-ray logN - logS curve is presented, but a detailed assessment requires further study. The 4 sigma limit of about 7 times 10 to the minus 15th power erg/s.sq cm (0.5 to 2.0 keV) is considerably deeper then the Einstein deep surveys, and of comparable sensitivity to the deepest current Rosat surveys. Cross correlation with our Four Shooter optical catalogs yields at least one likely optical candidate for nearly all of the Rosat x-ray sources; a number of the likely optical identifications have colors of quasi-stellar objects (and stellar PSF), but in other cases galaxies/groups are also viable candidates. ESA

N93-17133# Academy of Sciences, Potsdam (German D.R.).
ROSAT ALL SKY SURVEY OBSERVATIONS OF IRAS GALAXIES **c89**
T. Boller (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), E. J. A. Meurs (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), U. Zimmermann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), and H.-M. Adorf (European Southern Observatory, Garching, Germany) *In* MPI fuer Extraterristrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 231-234 (For primary document see N93-17094 05-90)
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A sample of 14708 extragalactic IRAS sources selected from the IRAS point source catalog via statistical classification were cross correlated with the Rosat All Sky Survey. An unexpected result is the discovery of several spiral galaxies with luminosities up to 10 to 43rd power erg/s well above those found with the Einstein satellite. This suggests as one possible explanation that the x-ray luminous spirals are starbursts which are characterized by steep spectra and thus are more easily detected by Rosat. ESA

N93-17134# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
THE X RAY PROPERTIES OF WARM IRAS GALAXIES
E. J. A. Meurs, T. Boller (Academy of Sciences, Potsdam, German D.R.), W. Brinkmann, H. H. Fink, G. K. Miley (Leiden Univ., Netherlands), and M. J. Ward (Oxford Univ., England) *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 235-237 (For primary document see N93-17094 05-90)
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Since galaxies with warm IRAS have been found to be good active galactic nuclei candidates, a selection of warm IRAS sources was studied in the Rosat All Sky Survey. Preliminary results on the type 1 and type 2 Seyferts in this sample are presented. An interesting result is the detection of 12 Seyfert type 2 IRAS galaxies, a considerably larger number of these objects than seen before at x-rays. ESA

N93-17135# Universidad Complutense, Madrid (Spain). Lab. de Astrofisica Espacial y Fisica Fundamental.

SOFT X RAY SEGREGATION OF SEYFERT GALAXIES **c89**

J. Miguel Mas-Hesse, I. F. Mirabel (Commissariat a l'Energie Atomique, Saclay, France), and H. U. Zimmermann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 238-241 (For primary document see N93-17094 05-90)

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With the aim of deriving the properties of the mechanisms powering emission line galaxies, the x-ray, optical, far infrared (FIR), and radio emission were analyzed in a sample of 103 galaxies, including 44 'normal' star forming galaxies, mostly spirals and irregulars, and 59 Active Galactic Nuclei (AGN) of different classes (quasi stellar objects, Seyfert 1 and Seyfert 2 galaxies). The objects were selected by having been detected both by Einstein and by IRAS (Infrared Astronomy Satellite) at 60 and/or 100 micrometers, discarding the targets for which only upper limits were available. Only those AGN with enough counts to perform spectral fits in the x-ray range were taken. The FIR luminosities were integrated over the 40 to 120 micrometers band by taking the IRAS fluxes at 60 to 100 micrometers. The x-ray luminosities correspond to the Einstein Image Proportional Counter (IPC) bands (generally between 0.5 and 4.0 keV) and were corrected from interstellar absorption. Both FIR and x-ray luminosities were transformed to zero resdshift. ESA

N93-17136# Leicester Univ. (England). Dept. of Physics and Astronomy.

A NEW LOOK AT RADIO/X RAY CORRELATIONS **c89**

R. S. Warwick and C. R. Barber *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 242-246 (For primary document see N93-17094 05-90)

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Preliminary results from a program to study the coincidence of faint radio sources with extragalactic x-ray sources detected in Rosat images are reported. The x-ray data consist of a number of Rosat pointings in a region of very low galactic N(sub H) (i.e. one of the 'Lockman Hole' regions). In a complementary program, deep radio maps of the Rosat fields were obtained with the Very Large Array (VLA) at a wavelength of 20 cm to a limiting flux density of 0.7 mJy. It was found that there is roughly a 10 percent overlap between the x-ray and radio source samples. A brief comparison is made with similar studies based on the Einstein x-ray surveys. ESA

N93-17137# Toronto Univ. (Ontario).

THE 10-YEAR MONITORING OF THE COMPACT RADIO SOURCES IN THE NUCLEAR REGIONS OF M82 **c89**

Philipp P. Kronberg and Richard A. Sramek (National Radio Astronomy Observatory, Tucson, AZ.) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 247-254 (For primary document see N93-17094 05-90)

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Results of repeated VLA (Very Large Array) observations of the inner 600 pc 'starburst' region of M82 at 5 and 15 GHz at 0.3 inch resolution are presented. A histogram of the fractional flux changes of the brightest ten sources over a ten and a half year period is presented which shows that the degree of variability is very different among the brightest sources. A histogram showing the distribution of the spectral index between 5 and 15 GHz is also presented. A map of the compact nuclear sources in M82 at 15 GHz, with combined A and B array data, is given. ESA

N93-17138# Cambridge Univ. (England). Inst. of Astronomy.

THE CENTRAL ENGINE OF AGN'S AND ITS COSMOLOGICAL EVOLUTION

Martin J. Rees *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 255-270 (For primary document see N93-17094 05-90)

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The continuum emission from the inner regions of Active Galactic Nuclei (AGN) is discussed. It is emphasized that a thermal UV component is a generic feature of accretion powered sources, and does not necessarily require a 'standard' disc; in particular, a model in which primary nonthermal radiation is reprocessed by small magnetically confined sheets or filaments with a small volume filling factor is discussed. The radio emission from compact sources is discussed. The possibility that stars may be captured in very tight orbits around massive black holes and that such stars could in principle cause periodic variations with periods as short as about 1 hour is discussed. The cosmogonic implications of the z dependence of the AGN populations (and particularly the problems posed by objects with z approximately equal to 5), and the nature and detectability of the AGN remants in the centers of quiescent nearby galaxies are considered. ESA

N93-17139# Osservatorio Astrofisico di Arcetri, Florence (Italy).

HI IN GALAXY OUTSKIRTS AND THE EXTRAGALACTIC IONIZING FLUX **c93**

Edvige Corbelli and Edwin E. Salpeter (Cornell Univ., Ithaca, NY.) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 271-274 (For primary document see N93-17094 05-90)

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The lack of starforming regions makes the ionizing background radiation extremely important for the physical conditions of the gas in the outskirts of spiral galaxies. Combining HI observations with models of the interaction between the ionizing radiation and the gas in these regions, the spectrum of the extragalactic background radiation below 0.2 keV can be constrained. The 21 cm absorption in the spectra of 60 background radio sources which lie close to the optical disk of spiral galaxies in the plane of the sky were sought. Measurements were made for high velocity clouds in the direction of 63 bright continuum sources. Results can be summarized as follows: the spin temperature is never so low as to be comparable with the microwave background radiation temperature. This implies that the brightness temperature is directly proportional to the column density and that there is no appreciable HI hidden in emission by extreme subthermal effects; absorption is never observed for column densities N(sub HI) less than or equal to 2 times 10 to the 19th power/sq cm. For N(sub HI) greater than 2 times 10 to the 19th power/sq cm absorption is sometimes seen but only over a narrow velocity range; there is a transitional column density N(sub I) such that appreciable emission is seen for N(sub HI) greater than N(sub I) but very little is seen for N(sub HI) less then N(sub I). ESA

N93-17140# Space Telescope Science Inst., Baltimore, MD.

THE X RAY BACKGROUND: PAST, PRESENT, AND FUTURE

Riccardo Giacconi and Richard Burg *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 275-290 Prepared in cooperation with Johns Hopkins Univ., Baltimore, MD (For primary document see N93-17094 05-90)

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Attempts made to resolve the sources of the X-Ray Background (XRB) since the discovery of its existence in 1962 are reviewed. Two main points of view have guided this work: the point source hypothesis and the diffuse hypothesis. The two hypothesis led to the design of very different sets of experiments with their own internal logic and progression; both sets are considered. Given the rich phenomenology revealed to date, it is clear that the properties of individual sources which contributed to the XRB at fainter and fainter fluxes will continue to be studied. The relative contribution of active nuclei and clusters of galaxies is considered. ESA

N93-17141*# Osservatorio Astronomico, Brera, Milan (Italy).

THE EVOLUTION OF AGN'S AT X RAY WAVELENGTHS

Tommaso Maccacaro, R. DellaCeca (Bologna Univ., Italy), I. M. Gioia (Consiglio Nazionale delle Ricerche, Bologna, Italy), J. T. Stocke (Colorado Univ., Boulder.), and A. Wolter *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 291-296 Sponsored in part by Italian Space Agency (For primary document see N93-17094 05-90)

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The cosmological evolution and the Luminosity Function (LF) of x-ray selected Active Galactic Nuclei (AGN) are discussed. The sample used is extracted from the Einstein Observatory Extended Medium Sensitivity Survey (EMSS) and consists of more than 420 objects. Preliminary results from

the Rosat all sky survey data confirm the correctness of the optical identification of the EMSS sources, thus giving confidence to the results obtained from the analysis of the AGN sample. The XLF observed at different redshifts gives direct evidence of cosmological evolution. Data were analyzed within the framework of luminosity evolution models and the two most common evolutionary forms were considered. Luminosity dependent evolution is required if the evolution function has the exponential form, whereas the simpler pure luminosity evolution model is still acceptable if the evolution function has the power law form. Using the whole sample of objects the number counts and the devolved XLF were derived. A comparison of the EMSS Data with preliminary Rosat results indicates an overall agreement. ESA

N93-17142*# California Univ., Berkeley. Center for Extreme Ultraviolet Astrophysics.

THE HARD X RAY LUMINOSITY FUNCTION AND EVOLUTION OF AGN

Herman L. Marshall *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 297-302 (For primary document see N93-17094 05-90)

(Contract NAS5-30180)

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A large number of active galactic nuclei and quasars detected by the HEAO A1 x-ray survey and recently identified using results from the HEAO A3 experiments are described and preliminary results are presented. The sample shows some incompleteness and is not completely identified, so these effects are taken out in the analysis by correcting the effective coverage of the survey. Preliminary analysis indicates that significant evolution can be detected in this data and that the evolution rate appears stronger than that inferred from a sample selected at lower energies. ESA

N93-17143# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.

ENERGY SPECTRUM OF THE COSMIC X RAY BACKGROUND: SOME CONSIDERATIONS BASED ON THE GINGA RESULTS c93

Y. Tanaka *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 303-314 (For primary document see N93-17094 05-90)

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What was known of the Cosmic X-Ray Background (CXRB) before Ginga and what was discovered because of Ginga are discussed. CXRB is now believed to be composed, for the most part, of discrete extragalactic sources. However, so far obtained spectra of the known classes of extragalactic sources do not account for the distinct shape of the CXRB spectrum with a break around 20 keV: 'spectral paradox'. Ginga observations yielded new results in the active galactic nuclei spectra and the logN - logS relation over a wide energy band above 2 keV at much lower flux levels than previously available. As a result, the spectral paradox has become even more serious. Based on the Ginga results, some possibilities for the spectra of fainter Active Galactic Nuclei than the Ginga limit which could explain the spectral break are discussed. ESA

N93-17144*# Columbia Univ., New York, NY. Astrophysics Lab.

WHERE HAVE ALL THE SOURCES GONE? c93

D. J. Helfand and T. T. Hamilton *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 314-320 (For primary document see N93-17094 05-90)

(Grants NAGw-2057; NAG8-183)

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In the continuing quest for an understanding of the cosmic x-ray background, the most difficult technical barrier remains the mismatch between the wavelength band in which the discrete source populations are best characterized (0.1 to 3.5 keV), and the band in which the spectrum of the background is well determined and the bulk of the energy density resides (3.5 to 50 keV). A progress report in an attempt to resolve this conundrum using the Einstein Imaging Proportional Counter (IPC) database and analysis system is presented. The IPC data base is described and how it can be used to search both for missing clusters of galaxies and highly obscured active galactic nuclei is addressed. All 4083 imaging proportional counter observations were examined after flat fielding and editing to optimize sensitivity for diffuse emission on various size scales ranging up to 10 feet. A '2 sigma source' catalog which, when filtered by matching with source catalogs from other wavelength regimes, is shown to reveal new source classes which may be significant contributors to the cosmic x-ray background is being constructed. Optimization techniques are described and the source catalogs which result are presented. Limits on the contributions both classes of sources make to resolving the discrepancy with the higher energy observations are set. ESA

N93-17145# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

ROSAT DEEP SURVEYS c89

G. Hasinger *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 321-331 (For primary document see N93-17094 05-90)

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A series of 20 deep pointed observations with the Rosat Position Sensitive Proportional Counter (PSPC) is discussed. 530 x-ray sources with 0.5 to 2 keV fluxes down to 3 times 10 to the -15th power erg/sq cm.s were discovered in 5.9 sq deg. The N (greater than S) relation of the sources selected in the 0.5 to 2 keV band shows a density in excess of 200 sq deg at the faintest fluxes and a flattening below 2 times 10 to the -14th power erg/sq cm.s. The average spectrum of these sources is a power law with energy index 1.2 +/- 0.1. The absorption column densities are consistent with the galactic HI columns. More than 50 percent of the 1 to 2 keV background was resolved into discrete sources in the deepest field. The total background spectrum shows an emission line feature around 0.65 keV, most probably due to OVII to OVIII from a 2,000,000K plasma. Above about 1 keV, the background is dominated by a power law spectrum with a normalization of 13.4 +/- 0.2 keV/sq cm s sr keV and a slope 1.2 +/- 0.1, that is, considerably steeper then the extrapolation from higher energies. An angular correlation function in the 0.9 to 2 keV band was constructed, averaged over 14 fields. The 1 sigma upper limits for structure in the background on scales of 2 to 10 arcmin are 10 to 5 percent. ESA

N93-17146# Institute of Physical and Chemical Research, Saitama (Japan).

ORIGIN OF THE COSMIC X RAY BACKGROUND RADIATION c93

Nobuo Terasawa *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 332-337 Sponsored in part by Inoue Foundation for Science (For primary document see N93-17094 05-90)

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The spectrum of the Cosmic X-ray Background (CXB) is characterized by the break around 20 keV. It is shown that the CXB spectrum is well reproduced by the superposition of Active Galactic Nuclei (AGN) spectra and no peculiar sources are needed to account for the CXB. Non-power-law components such as reflection component and a partial covering component in the AGN spectra are essential to reproduce the x-ray background spectrum. It is shown that the ultraviolet radiation from AGN can ionize intergalactic medium to be consistent with the Gunn-Peterson effect in the spectra of high redshift Quasi Stellar Objects (QSO's). It is shown that CXB is essentially explained by the superposition of x-ray radiation from AGN. Fairly low luminosity AGN have a dominant contribution to CXB. Reflection components and uniform absorbers are important for the spectra of AGN contributing to CXB. Partial absorber, which is found fairly in general in AGN spectra, can improve the predicted low energy spectra of CXB and this may suggest the contribution of Seyfert 2 galaxies. ESA

N93-17147# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

ON THE SUITABILITY OF STARBURST GALAXIES AS A CONTRIBUTOR TO THE CXRB c93

E. J. A. Meurs and T. Boller (Academy of Sciences, Potsdam, German D.R.) *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 338-340 (For primary document see N93-17094 05-90)

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In view of recent claims that starburst galaxies may account for a substantial fraction of the Cosmic X-Ray Background (CXRB), the possible contribution of the x-ray luminous spiral galaxies to the background is discussed. These spiral galaxies were revealed through Rosat all sky survey detections of IRAS galaxies, and are thought likely to be starburst galaxies

because of their high infrared luminosities and explicit optical classification. The latter objects, with spectral shapes dependent on the relative strengths of various, x-ray emitting stellar subpopulations, may however have too soft x-spectra to play a signifigant role in this respect. ESA

N93-17148# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

CONTRIBUTION OF CLUSTERS OF GALAXIES TO THE XRB **c93**

Marguerite Pierre *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 341-344 (For primary document see N93-17094 05-90)

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The contribution of clusters of galaxies to the diffuse cosmic X-Ray Background (XRB), as recently measured by Rosat deep pointings was investigated. The cluster population was modeled according to the local luminosity and temperature distributions, and cluster evolution assuming preheating of the intergalactic medium. The simulations suggest that the fraction of the XRB due to clusters should not exceed a few percent. ESA

N93-17149# Universidad de Santander (Spain). Departimento de Fisica Moderna.

ON THE ORIGIN OF THE X RAY BACKGROUND **c93**

X. Barcons *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 345-357 Sponsored in part by DGICYT (For primary document see N93-17094 05-90)

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A few issues concerning the origin of the X-Ray Background (XRB) are discussed. The contribution of hot gas (both diffuse and clumped) to the background intensity is found to be generally negligible. Since the Rosat deep surveys have already resolved a high fraction of the soft XRB, some properties (average spectrum, clustering, source counts) of the sources of the 'residual' intensity are studied. It is speculated that the role of low luminosity Seyfert galaxies might be relevant in the origin of the soft XRB. ESA

N93-17150# Universidad de Santander (Spain). Departimento de Fisica Moderna.

CLUSTERING PROPERTIES OF X RAY SOURCES FROM THE ANALYSIS OF THE GINGA P(D) DISTRIBUTION **c93**

L. Toffolatti (Osservatorio Astronomico, Padova, Italy) and X. Barcons *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 358-361 (For primary document see N93-17094 05-90)

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A P(D) analysis, the probability function of the fluctuations measured in integrated backgrounds using data from 132 independent samples measured at galactic latitudes in regions of the sky devoid of sources was performed. A figure illustrating the chi squared contours in the parameter space adopting a Euclidean slope for the N(greater than S) relation is given. The 1, 2, and 3 sigma probability levels and the star minimum fit are shown on the figure. A further similar figure is given, but the slope gamma = 1.6 for N(greater than S) relation is adopted. ESA

N93-17151# Universidad de Santander (Spain). Departimento de Fisica Moderna.

THE GINGA SATELLITE AND THE LARGE-SCALE STRUCTURE OF THE UNIVERSE

F. J. Carrera and X. Barcons *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 362-367 (For primary document see N93-17094 05-90)

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The isotropy of the x-ray sky (4 to 12 keV) was tested on scales of 2 to 13 degrees, leading to an upper limit of about 0.00013 (95 percent) for the autocorrelation function at 2 degrees. This limit constrains clustering of active galactic nuclei and clusters of galaxies. To achieve this result, a set of pointed exposures of the Ginga LAC (Large Area proportional Counter) detector were used. A second set of scan data, also from Ginga, were analyzed, showing no significative signal at any scale below 2 degrees. ESA

N93-17152# Leicester Univ. (England). X Ray Astronomy Group.

THE ROSAT AUTOCORRELATION FUNCTION OF THE X RAY BACKGROUND **c93**

I. Georgantopoulos, G. Stewart, R. Griffiths (Space Telescope Science Inst., Baltimore, MD.), T. Shanks (Durham Univ., England), and B. Boyle (Cambridge Univ., England) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 368-372 (For primary document see N93-17094 05-90)

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The Autocorrelation Function (ACF) of the x-ray background on arcminute angular scales using about 30 ksec Rosat exposures were derived. No significant signal was detected with the ACF being consistent with zero at all angular scales. The constraints that the upper limit on the ACF places on the contribution of active galactic nuclei and starbursts on the 0.5 to 2 keV background are discussed. ESA

N93-17153*# Seattle Univ., WA. Dept. of Astronomy.

QSO'S TO B LESS THAN 22 AND THE COSMIC X RAY BACKGROUND RADIATION: A FLUCTUATIONS CORRELATION APPROACH **c93**

S. F. Anderson and X. Wu *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 373-376 (For primary document see N93-17094 05-90)

(Grants NAG5-1254; NAG8-590; NAG5-1253)

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The contribution of faint Quasi Stellar Objects (QSO's) and other discrete sources to the cosmic X-Ray Background (XRB) is estimated using an optically selected QSO sample in SA 68.2 in conjunction with archived x-ray images from the Einstein Image Proportional Counter (IPC). A new generalization of the 'x-ray image stacking' technique is employed; this new approach tests for a positional 'correlation' between positive x-ray fluctuations in the IPC images, and the locations of the optically selected QSO's. Correlation with thirty SA 68.2 QSO's permits a highly sensitive measurement of the ensemble mean x-ray flux for QSO's with 19 less than B(sub J) less than 22. Although the IPC images are of modest depth, a limiting sensitivity 1.2 times 10 to the minus 14th power erg/sec/sq cm (0.3 to 3.5 keV) is effectively archieved comparable to that of the Rosat medium deep surveys. ESA

N93-17154# Hamburger Sternwarte G.m.b.H. (Germany).

IDENTIFICATION OF ROSAT AGN ON OBJECTIVE PRISM PLATES **c89**

N. Bade, M. Dahlem, D. Engels, D. Reimers, and W. Voges (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 377-382 (For primary document see N93-17094 05-90)

(Contracts DFG-Re-353/11-3; DFG-Re-353/22; BMFT-50-OR-90058)

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An identification process which provides positions and their errors for x-ray sources is outlined. 2500 sources have been examined from the Rosat all sky survey on objective prism plates which were taken in the course of the Hamburg Quasar Survey (HQS). Among other object classes more than 700 Active Galactic Nuclei (AGN) candidates were identified. In a first follow up observing run in May 1991, 43 AGN candidates were spectroscopically observed of which 41 were confirmed, that is a success of rate of 90 percent. The redshift and the log(f(sub x)/f(sub v)) distribution of the 41 AGN are, within the statistical uncertainties, similar to the distributions from the Einstein medium sensitivity survey. Six of the 43 AGN candidates are members of pairs or small groups of galaxies. Three of them have only narrow emission lines, one certainly being a narrow lined Seyfert 1 galaxy. The nature of the high x-ray luminosities of the other two sources is uncertain at present. Details of the compilation of a database in which all objects found in the Schmidt plates within the error circle of each examined Rosat detection are collected, and where an identification of the most likely candidate is given is described. ESA

N93-17155# Max-Planck-Inst. fuer Astrophysik, Garching (Germany).

SPECTROSCOPIC IDENTIFICATION OF X RAY SOFT AGN FOUND BY ROSAT **c89**

C.-C. Thomas, K. Beuermann (Technische Univ., Berlin, Germany), W. Brinkmann (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching,

Germany), H. H. Fink (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany), and W. Voges (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 383-386 (For primary document see N93-17094 05-90)

Copyright Avail: CASI HC A01/MF A04

First results from a program to spectroscopically identify x-ray sources such as soft Active Galactic Nuclei (AGN) found with Rosat in the all sky survey using the X-Ray Telescope (XRT) are presented. For this program, a flux limited sample of sources was extracted from the survey data. A subsample was created which contained only soft sources. Correlations to Simbad and several other catalogs served to remove known sources. In a first observing campaign in Sep. 1991, spectra were obtained for 28 sources, 14 of them showing emission lines at various redshift. The characteristics of these spectra (fluxes, redshifts, and line fluxes) are discussed together with x-ray spectra obtained for the three brightest sources in this sample. ESA

N93-17156# Florence Univ. (Italy). Dipartimento di Astronomia.

SELECTION OF FAINT QUASARS BASED ON VARIABILITY c89

A. Cimatti, G. Zamorani (Osservatorio Astronomico, Bologna, Italy), and B. Marano (Osservatorio Astronomico, Bologna, Italy) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 387-391 (For primary document see N93-17094 05-90)

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The optical variability of a quasar sample complete to B(sub J) = 22.0 was investigated in a 2 year time base and in three photometric bands (UJF). The percentage of variable quasars is high and it reaches about 50 percent of the sample. The results also indicate that 80 to 90 percent of the selected variable objects out of the total 3000 objects of the whole field, are confirmed quasars or objects with strong ultraviolet excesses. It was concluded that optical variability can be successfully used as an efficient and independent (or auxiliary) selection method in quasar surveys in order to obtain faint and complete samples useful to place strong constraints to the x-ray cosmic background. ESA

N93-17157# Osservatorio Astronomico, Bologna (Italy).

THE SURFACE DENSITY OF QUASARS AND SEYFERT GALAXIES AT B IS APPROXIMATELY 22.0

Giovanni Zamorani (Bologna Univ., Italy), Bruno Marano, Valentina Zitelli (Bologna Univ., Italy), Marco Mignoli (Bologna Univ., Italy), Andrea Cimatti (Bologna Univ., Italy), and Brian Boyle (Cambridge Univ., England) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 392-398 Sponsored in pary by Italian Space Agency (For primary document see N93-17094 05-90)

Copyright Avail: CASI HC A02/MF A04

Results obtained from a spectroscopically complete sample of 52 faint optically selected active galactic nuclei (quasars and Seyfert galaxies) with J less than or equal to 22.0 are presented and discussed. From a comparison of the quasars selected with three different selection, criteria (colors and variability) applied on the same field, the maximum level of incompleteness expected on the sample is estimated. Results for the counts of quasars as a function of magnitude in different redshift and luminosity ranges are presented and compared with those obtained from the analysis of a large composite sample resulting from the combination of ten different surveys. ESA

N93-17158# Cambridge Univ. (England). Inst. of Astronomy.

OPTICALLY SELECTED QUASARS WITH Z GREATER THAN 4 c89

R. G. McMahon, M. J. Irwin (Royal Greenwich Observatory, Cambridge, England), and C. Hazard (Pittsburgh Univ., PA.) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 399-407 (For primary document see N93-17094 05-90)

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Results of a wide field multicolor photographic survey for bright high redshift (z greater than 4) quasars are presented. No decline in the space density of these luminous high resdshift quasars compared to z = 2 quasars is apparent. Preliminary analysis of the emission line properties of this new sample of approximately 20 z greater than 4 quasars reveal a much wider dispersion in observed line strengths and profiles than is apparent in other samples of z greater than 4 quasars. Sensitive VLA (Very Large Array) radio observations of 29 optically selected quasars with redshifts in the range 3.5 less than z less than 4.7, in which 4 have been detected at 5 Ghz with S greater than 1 mJy were performed. Two of the radio loud quasars have redshifts greater than 4, with redshifts of 4.09 and 4.25, respectively. One of the other radio loud quasars may exhibit extended radio structure. A comparison with similar studies of quasars at lower redshift indicates that the radio properties of optically selected quasars were similar at z about 2 whereas at z less than 1 more quasars were radio loud. ESA

N93-17159# Osservatorio Astronomico, Bologna (Italy).

THE BALDWIN EFFECT IN COMPLETE OPTICALLY SELECTED SAMPLES OF QUASARS c89

Bruno Marano, Giovanni Zamorani (Consiglio Nazionale delle Ricerche, Bologna, Italy), Valentina Zitelli (Bologna Univ., Italy), Marco Mignoli (Bologna Univ., Italy), and Brian J. Boyle (Cambridge Univ., England) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 408-413 Sponsored in part by Italian Space Agency (For primary document see N93-17094 05-90)

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From an analysis of the Baldwin effect in five complete optically selected samples of quasars, it was found that the slope of the correlation between equivalent width and absolute luminosity is very shallow. In particular, it was found that EW(sub CIV) is proportional to L(sub 1550)(exp -0.13), significantly different from the previous 'canonical' slope of the Baldwin effect in quasars: EW(sub CIV) proportional to L(sub 1550)(exp(0.3 to 0.4)). While the data set is composed of optically selected quasars, the latter result was mainly based on the analysis of flat spectrum, radio loud quasars. It is likely that the enhanced optical variability of radio loud quasars may be the fundamental factor in producing the observed difference between the two correlations. Considering also the relatively large dispersion of the data, it was concluded that the equivalent width of the CIV line can not be used as a reliable luminosity indicator in quasars. ESA

N93-17160# Bologna Univ. (Italy). Ist. di Radioastronomia.

AGN AND THE X RAY BACKGROUND: CONCLUDING REMARKS c93

G. Setti (European Southern Observatory, Garching, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 414-420 (For primary document see N93-17094 05-90)

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Attention is focused on two specific issues, the first one dealing with the Active Galactic Nuclei (AGN) source counts and the soft X-Ray Background (XRB) and the second one with the AGN source models for the hard XRB where the dominant part of the XRB intensity is concentrated. The achronic AGN is used to include both the Sy nuclei of type 1, or low luminosity nuclei with an absolute magnitude M(sub B) greater than -23, and the quasars, or nuclei M(sub B) less than -23(q(sub 0) = 0; H(sub 0) = 50). Whenever necessary, specific reference to these two classes of objects is made. ESA

N93-17190# National Lab. for High Energy Physics, Tsukuba (Japan).

PROCEEDINGS OF THE FIFTH WORKSHOP ON ELEMENTARY-PARTICLE PICTURE OF THE UNIVERSE

Masataka Fukugita, ed. (Kyoto Univ., Japan) and Atsuto Suzuki, ed. 1991 371 p Presented at the 5th Workshop on Elementary Particle Picture of the Universe, Minami-Izu (Japan), 19-21 Nov. 1990 (DE92-538746; KEK-PROC-91-13; CONF-9011298) Avail: CASI HC A16/MF A03

The Fifth Workshop on the Elementary-Particle of the Universe was held at Minami-Izu, from 19-21, November, 1990. The 80 participants included high-energy physicists, nuclear physicists, cosmic-ray physicists, and astrophysicists, both from the theoretic and experimental fields. In this workshop, most of the time was given to reviews of the present status and prospects of the subjects of the present project as well as some others, in order to find future directions. A detector symposium was held to explore the applicability of new technologies. This publication collects the presented papers and transparencies. DOE

N93-17382# Los Alamos National Lab., NM.
CONVECTION IN RR LYRAE STARS
R. F. Stellingwerf and G. Bono (Trieste Univ., Italy) 1992 10 p Presented at the International Astronomical Union Colloquium 139 on New Perspectives on Stellar Pulsation and Pulsating Variable Stars, Victoria, Ontario, 7-11 Jul. 1992
(Contract W-7405-eng-36)
(DE93-000851; LA-UR-92-3144; CONF-9207156-2) Avail: CASI HC A02/MF A01

Convection undoubtedly plays a strong role in defining the RR Lyrae instability strip, but its effects on amplitude, mode of pulsation, and light curve have always been problematical. One reason is simply that convective models are difficult to compute, and their accuracy is difficult to ascertain. We present results of a new convective survey of RR Lyrae stars that constitute the best models available at this time, with better boundary conditions, physics, zoning, and length of computational run than previous results. DOE

N93-17384# Los Alamos National Lab., NM.
THE DEPENDENCE OF PULSATING AURORAL EVENTS ON ENERGETIC ELECTRONS AND COLD PLASMA NEAR THE EQUATORIAL PLANE
R. J. Nemzek, R. D. Belian, D. J. McComas, M. F. Thomsen, R. Nakamura, and D. N. Baker 1992 7 p Presented at the 19th Annual European Meeting on Atmospheric Studies by Optical Methods, Kiruna (Sweden), 10-14 Aug. 1992
(Contract W-7405-eng-36)
(DE93-000856; LA-UR-92-3079; CONF-9208162-1) Avail: CASI HC A02/MF A01

Pulsating auroras are a substorm recovery phase phenomenon, occurring shortly after an auroral breakup. The current theory of the pulsating aurora involves a 'relaxation oscillator' mechanism requiring a population of high-energy (10's of keV) electrons and a low-energy plasma number density on the order of a few particles per cu cm. We investigated this relationship by comparing energetic electron and plasma data from a geosynchronous satellite to pulsating auroras recorded by an all-sky video camera which contained the satellite's ionospheric conjugate point in its field of view. Pulsating auroral events were generally closely connected to substorm injections on the satellite, but there was no clear correlation with changes in plasma density. During all of the events the density was in an acceptable range for the relaxation oscillator mechanism to function. The relationship to substorm injections implies that the pulsating aurora can be used to map the substorm injection region down to the ionosphere. An unusual diminishing of the pulsating aurora during the growth phase of a subsequent substorm was also discovered. DOE

N93-17387# Los Alamos National Lab., NM.
NUCLEAR MASSES AND FISSION BARRIERS FOR ASTROPHYSICAL APPLICATIONS
P. Moeller, J. R. Nix, K. L. Kratz, A. Woehr (Mainz Univ., Germany), and F. K. Thielemann (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.) 1992 21 p Presented at the Workshop on Nuclear Physics in the Universe, Oak Ridge, TN, 24-26 Sep. 1992
(Contract W-7405-eng-36)
(DE93-000869; LA-UR-92-3189; CONF-9209239-1) Avail: CASI HC A03/MF A01

We review the current status of the macroscopic-microscopic method for calculating nuclear masses, fission barriers and other nuclear-structure quantities of interest in astrophysical applications. We discuss what would be some minimal requirements of a nuclear mass model and study how the macroscopic-microscopic method and other nuclear mass models fullfil such basic requirements. Finally, we discuss some results of astrophysical calculations based on macroscopic-microscopic nuclear-structure models. DOE

N93-17410*# Columbia Univ., New York, NY. Dept. of Astronomy and Physics.
A THEORETICAL ANALYSIS OF THERMAL RADIATION FROM NEUTRON STARS Annual Status Report, 1 Apr. 1992 - 31 Mar. 1993
James H. Applegate 12 Jan. 1993 19 p
(Grant NAGw-3075)
(NASA-CR-191906; NAS 1.26:191906; CAL-2045) Avail: CASI HC A03/MF A01

As soon as it was realized that the direct URCA process is allowed by many modern nuclear equation of state, an analysis of its effect on the cooling of neutron stars was undertaken. A primary study showed that the occurrence of the direct URCA process makes the surface temperature of a neutron star suddenly drop by almost an order of magnitude when the cold wave from the core reaches the surface when the star is a few years old. The results of this study are published in Page and Applegate. As a work in progress, we are presently extending the above work. Improved expressions for the effect of nucleon pairing on the neutrino emissivity and specific heat are now available, and we have incorporated them in a recalculation of rate of the direct URCA process. For individual title, see N93-17411.

N93-17411*# Columbia Univ., New York, NY. Dept. of Astronomy.
THE GEMINGA NEUTRON STAR: EVIDENCE FOR NUCLEON SUPERFLUIDITY AT VERY HIGH DENSITY
Dany Page *In its* A Theoretical Analysis of Thermal Radiation from Neutron Stars 12 Jan. 1993 12 p (For primary document see N93-17410 05-90)
(Grant NAGw-3075)
Avail: CASI HC A03/MF A01

A comparison of the recent age and temperature estimates of the Geminga neutron star with cooling models is presented. This star is already in the photon cooling era and it is shown that its temperature can be understood within both the slow and fast neutrino emission scenarios and consequently will not allow discrimination between these two scenarios. However in both cases agreement of the theoretical cooling curves with the observed temperature depends crucially on the presence of nucleon pairing in most, if not all, of the core. Author

N93-17638# Royal Inst. of Tech., Stockholm (Sweden). Alfven Lab.
MANIFESTATIONS OF ELECTRIC CURRENTS IN INTERSTELLAR MOLECULAR CLOUDS
P. Carlqvist and G. F. Gahm (Stockholm Observatory, Sweden) Dec. 1991 21 p
(TRITA-EPP-91-05; ETN-92-92626) Avail: CASI HC A03/MF A01

Filamentary structures in molecular clouds and the existence of subfilaments of sinusoidal shape and also of helixlike structures are investigated. For two dark clouds, the Lynds 204 complex and the Sandqvist 187-188 complex, such shapes and the possible existence of helices wound around the main filaments are studied. All these features suggest the existence of electric currents and magnetic fields in these clouds. On the basis of a generalization of the Bennett pinch model, the magnitudes of the currents expected to flow in the filaments are derived. Values of column densities, magnetic field strengths, and direction of the fields are derived from observations. Magnetic fields with both toroidal and axial components are considered. The study shows that axial currents of the order of a few times 10 to the 13th power A are necessary for the clouds to be in equilibrium. The mean electron velocities are of the order of 0.01 to 0.00001 m/s, much lower than the thermal velocities in the clouds. It is suggested that helical structures may evolve as a result of various instabilities in the pinched clouds. Attention is given to the kink instability in connection with the sinusoidal shapes. The existence of electromagnetically controlled features in the interstellar clouds can be tested by further observations. ESA

N93-17639# Royal Inst. of Tech., Stockholm (Sweden). Alfven Lab.
PHYSICS OF THE AURORA
Carl-Gunne Faelthammar 1991 23 p Presented at 2nd Latin American Conference on Space Geophysics, Cuernavaca, Mexico, 8-11 Jul. 1991 Submitted for publication
(TRITA-EPP-91-06; ETN-92-92627) Avail: CASI HC A03/MF A01

The following observations of the aurora and related phenomena are discussed: auroral emissions, auroral ovals, connection to the magnetosphere, auroral current system, acceleration processes, magnetic field aligned electric fields, auroral waves, auroral electrodynamics, and chemical separation. The observations show that the behavior of the space plasma is dominated by plasma physical processes that were previously in some cases disregarded, in other cases altogether unknown. Most of these processes are involved in the physics of the aurora. Plasma processes

must be expected to be similarly important in the cosmical environments, as these are without exception in the plasma state. What was learned, and what remains to be learned in the study of the aurora provides a better understanding of our plasma universe and how it evolved to the present state. ESA

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N93-15829*# Space Telescope Science Inst., Baltimore, MD.

ULTRAVIOLET OBSERVATIONS OF CLOSE-BINARY AND PULSATING NUCLEI OF PLANETARY NEBULAE; WINDS AND SHELLS AROUND LOW-MASS SUPERGIANTS; THE CLOSE-BINARY NUCLEUS OF THE PLANETARY NEBULA HFG-1; A SEARCH FOR BINARY NUCLEI OF PLANETARY NEBULAE; UV MONITORING OF IRREGULARLY VARIABLE PLANETARY NUCLEI; AND THE PULSATING NUCLEUS OF THE PLANETARY NEBULA Lo 4 Final Report, 1 Oct. 1986 - 31 Dec. 1991

Howard E. Bond Dec. 1992 4 p

(Grant NAG5-855)

(NASA-CR-191634; NAS 1.26:191634) Avail: CASI HC A01/MF A01

A brief summary of the research highlights is presented. The topics covered include the following: binary nuclei of planetary nebulae; other variable planetary nuclei; low-mass supergiants; and other IUE-related research. Author

N93-16630*# Lunar and Planetary Inst., Houston, TX.

WORKSHOP ON INNOVATIVE INSTRUMENTATION FOR THE IN SITU STUDY OF ATMOSPHERE-SURFACE INTERACTIONS ON MARS

Bruce Fegley, Jr., ed. and Heinrich Waenke, ed. 1992 16 p Workshop held at Max-Planck-Inst., Mainz, Germany, 8-9 Oct. 1992

(Contract NASw-4574)

(NASA-CR-191638; NAS 1.26:191638; LPI/TR-92-07-Pt-2) Avail: CASI HC A03/MF A01

The speakers in the first session of the workshop addressed some of the continuing enigmas regarding the atmospheric composition, surface composition, and atmosphere-surface interactions on Mars; provided a description of a database of proposed payloads and instruments for SEI missions that is scheduled to be accessible in 1993; discussed potential uses of atmospheric imaging from landed stations on Mars; and advocated the collection and employment of high-spectral-resolution reflectance and emission data. Author

N93-16857*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SPACE RESOURCES. VOLUME 4: SOCIAL CONCERNS

Mary Fae McKay, ed., David S. McKay, ed., and Michael B. Duke, ed. 1992 315 p Original contains color illustrations

(NASA-SP-509-Vol-4; S-689-Vol-4; NAS 1.21:509-Vol-4; ISBN-0-16-038062-6; LC-92-4468) Avail: CASI HC A14/MF A03; SOD HC; 4 functional color pages

Space resources must be used to support life on the Moon and exploration of Mars. This volume, Social Concerns, covers some of the most important issues which must be addressed in any major program for the human exploration of space. The volume begins with a consideration of the economics and management of large scale space activities. Then the legal aspects of these activities are discussed, particularly the interpretation of treaty law with respect to the Moon and asteroids. The social and cultural issues of moving people into space are considered in detail, and the eventual emergence of a space culture different from the existing culture is envisioned. The environmental issues raised by the development of space settlements are faced. Some innovative approaches are proposed to space communities and habitats and self-sufficiency is considered along with human safety at a lunar base or outpost. For individual titles, see N93-16858 through N93-16868.

N93-16858*# Andersen (Arthur) and Co., New York, NY.

NASA IN THE 21ST CENTURY: A VISION OF GREATNESS **c12**

Kathleen J. Murphy *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 16-119 (For primary document see N93-16857 05-91)

Avail: CASI HC A06/MF A03; SOD HC; 4 functional color pages

Notions of greatness are discussed that have guided NASA in the past, values are presented that might be delivered by NASA in the future, and the the skills required for NASA to execute a vision of greatness are examined. Three possible patterns of space development by NASA are reviewed: (1) a mission to protect the ecology of the Earth; (2) the engineering of the technologies critical to space transportation and a healthy, productive life in space; and (3) the management of a major nonterrestrial resource project. Potential sources of funds are discussed along with opportunities for sustainable collaboration, and the life cycle of NASA's funding responsibility for its space development program. Author

N93-16859*# California Univ., San Diego, La Jolla. California Space Inst.

THE FUTURE OF MANAGEMENT: THE NASA PARADIGM **c81**

Philip R. Harris *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 120-142 (For primary document see N93-16857 05-91)

Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

Prototypes of 21st century management, especially for large scale enterprises, may well be found within the aerospace industry. The space era inaugurated a number of projects of such scope and magnitude that another type of management had to be created to ensure successful achievement. The challenges will be not just in terms of technology and its management, but also human and cultural in dimension. Futurists, students of management, and those concerned with technological administration would do well to review the literature of emerging space management for its wider implications. NASA offers a paradigm, or demonstrated model, of future trends in the field of management at large. More research is needed on issues of leadership for Earth based project in space and space based programs with managers there. It is needed to realize that large scale technical enterprises, such as are undertaken in space, require a new form of management. NASA and other responsible agencies are urged to study excellence in space macromanagement, including the necessary multidisciplinary skills. Two recommended targets are the application of general living systems theory and macromanagement concepts for space stations in the 1990s. E.R.

N93-16860*# Texas Univ., Austin.

SPACE LAW AND SPACE RESOURCES **c84**

Nathan C. Goldman *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 143-153 (For primary document see N93-16857 05-91)

Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

Space industrialization is confronting space law with problems that are changing old and shaping new legal principles. The return to the Moon, the next logical step beyond the space station, will establish a permanent human presence there. Science and engineering, manufacturing and mining will involve the astronauts in the settlement of the solar system. These pioneers, from many nations, will need a legal, political, and social framework to structure their lives and interactions. International and even domestic space law are only the beginning of this framework. Dispute resolution and simple experience will be needed in order to develop, over time, a new social system for the new regime of space. Author

N93-16861*# California Univ., San Diego, La Jolla. California Space Inst.

STRATEGIES FOR BROADENING PUBLIC INVOLVEMENT IN SPACE DEVELOPMENTS **c80**

Philip R. Harris et al *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 154-163 (For primary document see N93-16857 05-91)

Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

There is widespread public interest in and goodwill toward the space program. For NASA's plans for the next 25 years to be achieved, this public reservoir of support needs to be tapped and channeled. NASA endeavors have to reach out beyond the scientific, technological, and aerospace communities to foster wider participation in space exploration and exploitation. To broaden NASA support and spread out the financing

of space activities, recommendations for consideration are offered in the area of economics, political, institutional, international, and managerial areas. Author

N93-16862*# Hawaii Univ., Honolulu.
SPACE MIGRATIONS: ANTHROPOLOGY AND THE HUMANIZATION OF SPACE **c54**
Ben R. Finney *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 164-188 Repr. from Acta Astronautica, v. 15, 1987 p 189-194 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

Because of its broad evolutionary perspective and its focus on both technology and culture, anthropology offers a unique view of why we are going into space and what leaving Earth will mean for humanity. In addition, anthropology could help in the humanization of space through (1) overcoming socioculture barriers to working and living in space, (2) designing societies appropriate for permanent space settlement, (3) promoting understanding among differentiated branches of humankind scattered through space, (4) deciphering the cultural systems of any extraterrestrial civilizations contacted. Author

N93-16863*# California Univ., San Diego, La Jolla. California Space Inst.
THE INFLUENCE OF CULTURE ON SPACE DEVELOPMENTS
Philip R. Harris *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 189-219 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

N93-16864*# Texas Univ., San Antonio.
FUTURE SPACE DEVELOPMENT SCENARIOS: ENVIRONMENTAL CONSIDERATIONS **c12**
Richard Tangum *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 220-230 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

The formation of positive attitudes and values concerning the environment of space, as the basis for assuming a wise stewardship role, is becoming increasingly important as many nations begin their journeys into space. A strong emphasis should be placed on fostering an international space environmental ethics. The object of environmental assessment and management in space should be to define what interplanetary regulatory procedures are needed to avoid unnecessary environmental damage and to monitor the effectiveness of such avoidance. The first requirement for research is to narrow the field of concern to areas where there could be an increased scale of development in space in the immediate future. Research needs to be focused on methodologies for defining the environmental systems involved (e.g., the lunar surface) and then recognizing key variables in the system that are fragile and need to be respected. Criteria for environmental quality should emerge which identify, in the case of lunar surface, how much mining activity can be safely undertaken and what quantity of exhaust gases can be released over a given period of time. Only then will humans be most able to evaluate the likely consequences of ventures into space. Author

N93-16865*# California Univ., Los Angeles.
APPLICATIONS OF LIVING SYSTEMS THEORY TO LIFE IN SPACE **c54**
James Grier Miller *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 231-259 Presented at the NASA-NSF Conference on the Human Experience in Antarctica: Applications to Life in Space, Sunnyvale, CA, 17 Aug. 1987 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

The conceptual system and methodology of living systems theory appear to be of value to research on life in isolated environments. A space station, which must provide suitable conditions for human life in a stressful environment that meets none of the basic needs of life, is an extreme example of such isolation. A space station would include living systems at levels of individual human beings, groups of people engaged in a variety of activities, and the entire space crew as an organization. It could also carry living systems of other species, such as other animals and plants. Using the subsystem analysis of living systems theory, planners of a station, either in space or on a celestial body, would make sure that all the requirements for survival at all these levels had been considered. Attention would be given not only to the necessary matter and energy, but also the essential information flows that integrate and control living systems. Many variables for each subsystem could be monitored and kept in steady states. Use of living systems process analysis of the five flows of matter energy and information would assure that all members of the crew received what they needed. Author

N93-16866*# State Univ. of North Texas, Denton.
LIFE SUPPORT AND SELF-SUFFICIENCY IN SPACE COMMUNITIES **c54**
Karl R. Johansson *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 260-271 (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

The development of a controlled ecological life support system (CELSS) is necessary to enable the extended presence of humans in space, as on the Moon or on another planetary body. Over a long period, the provision of oxygen, water, and food, and protection from such inimical agents as radiation and temperature extremes, while maintaining the psychological health of the subjects, becomes prohibitively expensive if all supplies must be brought from Earth. Thus, some kind of a regenerative life support system within an enclosure or habitat must be established, thereby cutting the umbilicus to Mother Earth, but not irreversibly. This protective enclosure will enable the survival and growth of an assemblage of terrestrial species of microorganisms, plants, and animals. It is envisioned that the nonterrestrial ecosystem will evolve through the sequential introduction of terrestrial and local materials, together with the appropriate living forms. Author

N93-16867*# Washington Univ., Saint Louis, MO.
HUMAN SAFETY IN THE LUNAR ENVIRONMENT **c54**
Robert H. Lewis *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 272-294 Original contains color illustrations (For primary document see N93-16857 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

Any attempt to establish a continuously staffed base or permanent settlement on the Moon must safely meet the challenges posed by the Moon's surface environment. This environment is drastically different from the Earth's, and radiation and meteoroids are significant hazards to human safety. These dangers may be mitigated through the use of underground habitats, the piling up of lunar materials as shielding, and the use of teleoperated devices for surface operations. The lunar environment is detailed along with concepts for survival. E.R.

N93-16868*# California Univ., San Diego, La Jolla. California Space Inst.
SUMMER STUDY POSTSCRIPT: A 1986 PERSPECTIVE **c81**
Philip R. Harris et al *In* NASA. Johnson Space Center, Space Resources. Volume 4: Social Concerns 1992 p 295-299 (For primary document see N93-16857 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

Now that the National Commission on Space has set out bold goals and strategies for the American space program in the nest 50 years, how these visions can be turned into reality is examined. Since the Challenger tragedy and other space failures have brought about a crisis of confidence at NASA, innovations are necessary to rebuild public consensus and support. Initiatives by the private sector must promote the peaceful use of space by its exploration and industrialization. The faculty fellows from the 1984 summer study propose three possibilities for action by NASA and supporters of the space program. They are: A national lottery for space enterprises; A White House conference on space enterprise; and Reorganization of NASA. These ideas are briefly explored. and exploitation of space resources, such as on the asteroids and on Mars. Author

N93-16869*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE RESOURCES. OVERVIEW
Mary Fae McKay, ed., David S. McKay, ed., and Michael B. Duke, ed.

1992 42 p Original contains color illustrations
(NASA-SP-509; S-689; NAS 1.21:509; ISBN-0-16-038062-6; LC-92-4468)
Avail: CASI HC A03/MF A01; SOD HC: 7 functional color pages

Space resources must be used to support life on the Moon and in the exploration of Mars. Just as the pioneers applied the tools they brought with them to resources they found along the way rather than trying to haul all their needs over a long supply line, so too must space travelers apply their high technology tools to local resources. This overview describes the findings of a study on the use of space resources in the development of future space activities and defines the necessary research and development that must precede the practical utilization of these resources. Space resources considered included lunar soil, oxygen derived from lunar soil, material retrieved from near-Earth asteroids, abundant sunlight, low gravity, and high vacuum. The study participants analyzed the direct use of these resources, the potential demand for products from them, the techniques for retrieving and processing space resources, the necessary infrastructure, and the economic tradeoffs. Author

N93-16870*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE RESOURCES. VOLUME 1: SCENARIOS
Mary Fae McKay, ed., David S. McKay, ed., and Michael B. Duke, ed. 1992 69 p Original contains color illustrations
(NASA-SP-509-Vol-1; S-689-Vol-1; NAS 1.21:509-Vol-1; ISBN-0-16-038062-6; LC-92-4468) Avail: CASI HC A04/MF A01; SOD HC; 4 functional color pages

A number of possible future paths for space exploration and development are presented. The topics covered include the following: (1) the baseline program; (2) alternative scenarios utilizing nonterrestrial resources; (3) impacts of sociopolitical conditions; (4) common technologies; and issues for further study. For individual titles, see N93-16871 through N93-16874.

N93-16871*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
BASELINE PROGRAM
Barney B. Roberts and Jesco vonPuttkamer (National Aeronautics and Space Administration, Washington, DC.) *In its* Space Resources. Volume 1: Scenarios 1992 p 3-7 (For primary document see N93-16870 05-91)
Avail: CASI HC A01/MF A01; SOD HC; 4 functional color pages

This assumed program was developed from several sources of information and is extrapolated over future decades using a set of reasonable assumptions based on incremental growth. The assumptions for the NASA baseline program are as follows: balanced emphasis in four domains; a constant level of activity; low to moderate real budget growth; maximum use of commonality; and realistic and practical technology development. The first domain is low Earth Orbit (LEO). Activities there are concentrated on the space station but extend on one side to Earth-pointing sensors for unmanned platforms and on the other to the launch and staging of unmanned solar system exploration missions. The second domain is geosynchronous Earth orbit (GEO) and cislunar space. Activities here include all GEO missions and operations, both unmanned and manned, and all transport of materials and crews between LEO and the vicinity of the Moon. The third domain is the Moon itself. Lunar activities are to include both orbiting and landing missions; the landings may be either unmanned or manned. The last domain is Mars. Missions to Mars will initially be unmanned but they will eventually be manned. Program elements and descriptions are discussed as are critiques of the NASA baseline. Author

N93-16872*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ALTERNATIVE SCENARIOS UTILIZING NONTERRESTRIAL RESOURCES
Charles H. Eldred and Barney B. Roberts (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.) *In* NASA. Johnson Space Center, Space Resources. Volume 1: Scenarios 1992 p 8-26 (For primary document see N93-16870 05-91)
Avail: CASI HC A03/MF A01; SOD HC; 4 functional color pages

A collection of alternative scenarios that are enabled or substantially enhanced by the utilization of nonterrestrial resources is provided. We take a generalized approach to scenario building so that our report will have value in the context of whatever goals are eventually chosen. Some of the topics covered include the following: lunar materials processing; asteroid mining; lunar resources; construction of a large solar power station; solar dynamic power for the space station; reduced gravity; mission characteristics and options; and tourism. Author

N93-16873*# Hawaii Univ., Honolulu.
IMPACTS OF SOCIOPOLITICAL CONDITIONS
Ben R. Finney *In* NASA. Johnson Space Center, Space Resources. Volume 1: Scenarios 1992 p 27-40 Original contains color illustrations (For primary document see N93-16870 05-91)
Avail: CASI HC A03/MF A01; SOD HC; 4 functional color pages

Space development scenarios and the choice of technologies to carry them out depend upon the future social, economic, and political factors. A brief discussion concerning the impact of sociopolitical conditions on space exploration is presented. Some of the topics mentioned include: space weapons/warfare, international cooperation, NASA's Search for Extraterrestrial Intelligence (SETI) Program, and superpower rivelry. Author

N93-16874*# Eagle Engineering, Inc., Houston, TX.
ISSUES FOR FURTHER STUDY
Hubert P. Davis *In* NASA. Johnson Space Center, Space Resources. Volume 1: Scenarios 1992 p 41-58 (For primary document see N93-16870 05-91)
Avail: CASI HC A03/MF A01; SOD HC; 4 functional color pages

The topics covered include the following: a lunar outpost map, lunar resource utilization, asteroid resource utilization, space energy utilization, and space 'real estate' utilization. Author

N93-16875*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE RESOURCES. VOLUME 3: MATERIALS
Mary Fae McKay, ed., David S. McKay, ed., and Michael B. Duke, ed. 1992 331 p Original contains color illustrations
(NASA-SP-509-Vol-3; S-689-Vol-3; NAS 1.21:509-Vol-3; ISBN-0-16-038062-6; LC-92-4468) Avail: CASI HC A15/MF A03; SOD HC; 4 functional color pages

Space Resources addresses the issues of using space resources to support life on the Moon and for exploration of Mars. This volume - Materials - covers a number of technical and policy issues regarding the materials in space (mainly lunar and asteroidal) which can be used to support space operations. In part 1, nature and location of these materials, exploration strategy, evaluation criteria, and the technical means to collect or mine these materials is discussed. A baseline lunar mine and the basics of asteroid mining are presented and critiqued. In part 2, the beneficiation of ores and the extraction of such materials as oxygen, metals, and the makings of concrete are discussed. In part 3, the manufacturing and fabrication of nonterrestrial products are discussed. The economic tradeoffs between bringing needed products from Earth and making these products on location in space is considered. For individual titles, see N93-16876 through N93-16904.

N93-16876*# Colorado School of Mines, Golden.
TO BUILD A MINE: PROSPECT TO PRODUCT
Richard E. Gertsch *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 4-14 (For primary document see N93-16875 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

The terrestrial definition of ore is a quantity of earth materials containing a mineral that can be extracted at a profit. While a space-based resource-gathering operation may well be driven by other motives, such an operation should have the most favorable cost-benefit ratio possible. To this end, principles and procedures already tested by the stringent requirements of the profit motive should guide the selection, design, construction, and operation of a space-based mine. Proceeding from project initiation to a fully operational mine requires several interacting and overlapping steps, which are designed to facilitate the decision process and insure economic viability. The steps to achieve a fully operational mine are outlined. Presuming that the approach to developing nonterrestrial resources will parallel that for developing mineral resources on Earth, we can speculate on some of the problems associated with developing lunar

and asteroidal resources. The baseline for our study group was a small lunar mine and oxygen extraction facility. The development of this facility is described in accordance with the steps outlined. Author

N93-16877*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LUNAR EXPLORATION FOR RESOURCE UTILIZATION
Michael B. Duke *In its* Space Resources. Volume 3: Materials 1992 p 15-18 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

The strategy for developing resources on the Moon depends on the stage of space industrialization. A case is made for first developing the resources needed to provide simple materials required in large quantities for space operations. Propellants, shielding, and structural materials fall into this category. As the enterprise grows, it will be feasible to develop additional sources - those more difficult to obtain or required in smaller quantities. Thus, the first materials processing on the Moon will probably take the abundant lunar regolith, extract from it major mineral or glass species, and do relatively simple chemical processing. We need to conduct a lunar remote sensing mission to determine the global distribution of features, geophysical properties, and composition of the Moon, information which will serve as the basis for detailed models of and engineering decisions about a lunar mine. Author

N93-16878*# Texas Univ., Dallas.
LUNAR MATERIAL RESOURCES: AN OVERVIEW
James L. Carter *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 19-49 (For primary document see N93-16875 05-91)
(Grant NAG9-99)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

The analysis of returned lunar samples and a comparison of the physical and chemical processes operating on the Moon and on the Earth provide a basis for predicting both the possible types of material resources (especially minerals and rocks) and the physical characteristics of ore deposits potentially available on the Moon. The lack of free water on the Moon eliminates the classes of ore deposits that are most exploitable on Earth; namely, (1) hydrothermal, (2) secondary mobilization and enrichment, (3) precipitation from a body of water, and (4) placer. The types of lunar materials available for exploitation are whole rocks and their contained minerals, regolith, fumarolic and vapor deposits, and nonlunar materials, including solar wind implantations. Early exploitation of lunar material resources will be primarily the use of regolith materials for bulk shielding; the extraction from regolith fines of igneous minerals such as plagioclase feldspars and ilmenite for the production of oxygen, structural metals, and water; and possibly the separation from regolith fines of solar-wind-implanted volatiles. The only element, compound, or mineral, that by itself has been identified as having the economic potential for mining, processing, and return to Earth is helium-3. Author

N93-16879*# Rensselaer Polytechnic Inst., Troy, NY.
GROUND-BASED OBSERVATION OF NEAR-EARTH ASTEROIDS c89
Michael J. Gaffey *In* NASA. John Space Center, Space Resources. Volume 3: Materials 1992 p 50-58 (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

An increased ground-based observation program is an essential component of any serious attempt to assess the resource potential of near-Earth asteroids. A vigorous search and characterization program could lead to the discovery and description of about 400 to 500 near-Earth asteroids in the next 20 years. This program, in conjunction with meteorite studies, would provide the data base to ensure that the results of a small number of asteroid-rendezvous and sample-return missions could be extrapolated with confidence into a geological base map of the Aten, Apollo, and Amor asteroids. Ground-based spectral studies of nearly 30 members of the Aten/Apollo/Amor population provide good evidence that this class includes bodies composed of silicates, metal-silicates, and carbonaceous assemblages similar to those found in meteorites. The instruments that are being used or could be used to search for near-Earth asteroids are listed. Techniques useful in characterizing asteroids and the types of information obtainable using these techniques are listed. Author

N93-16880*# Arizona Univ., Tucson.
ASTEROID RESOURCES
John S. Lewis *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 59-78 (For primary document see N93-16875 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

There are three types of possible asteroidal materials that appear to be attractive for exploitation: (1) volatiles, (2) free metals, and (3) bulk dirt. Because some of the near-Earth asteroids are energetically more accessible than the Moon (require a round-trip total change in velocity less than 9 km/sec, though the trip time would be measured in years not days), such an asteroid might be chosen as the source of any useful material, even if that material was also available on the Moon. Provided that the asteroid was minable, it might therefore be chosen as the source of bulk dirt needed for shielding in low Earth orbit (LEO) or elsewhere in near-Earth space. And the near-Earth asteroids may offer materials that are rare or absent on the surface of the Moon. The relationship between asteroids and meteorites is discussed. A brief overview of the entire range of meteorite compositions, with emphasis on the occurrence of interesting resources is presented. Focus is on materials useful in space, especially volatiles, metals, and raw dirt. Those few materials that may have sufficiently high market value to be worth returning to Earth will be mentioned. Author

N93-16881*# ZZZZ CASI's Temporary In-Processing Code ZZZZ
LUNAR RESOURCE EVALUATION AND MINE SITE SELECTION
A. Edward Bence *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 79-84 (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

Two scenarios in this evaluation of lunar mineral resources and the selection of possible mining and processing sites are considered. The first scenario assumes that no new surface or near-surface data will be available before site selection (presumably one of the Apollo sites). The second scenario assumes that additional surface geology data will have been obtained by a lunar orbiter mission, an unmanned sample return mission (or missions), and followup manned missions. Regardless of the scenario, once a potentially favorable mine site has been identified, a minimum amount of fundamental data is needed to assess the resources at that site and to evaluate its suitability for mining and downstream processing. Since much of the required data depends on the target mineral(s), information on the resource, its beneficiation, and the refining, smelting, and fabricating processes must be factored into the evaluation. The annual capacity and producing lifetime of the mine and its associated processing plant must be estimated before the resource reserves can be assessed. The available market for the product largely determines the capacity and lifetime of the mine. The Apollo 17 site is described as a possible mining site. The use of new sites is briefly addressed. Author

N93-16882*# Arizona Univ., Tucson.
LUNAR SITE CHARACTERIZATION AND MINING
Charles E. Glass *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 85-94 Original contains color illustrations (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

Lunar mining requirements do not appear to be excessively demanding in terms of volume of material processed. It seems clear, however, that the labor-intensive practices that characterize terrestrial mining will not suffice at the low-gravity, hard-vacuum, and inaccessible sites on the Moon. New research efforts are needed in three important areas: (1) to develop high-speed, high-resolution through-rock vision systems that will permit more detailed and efficient mine site investigation and characterization; (2) to investigate the impact of lunar conditions on our ability to convert conventional mining and exploration equipment to lunar prototypes; and (3) to develop telerobotic or fully robotic mining systems for operations on the Moon and other bodies in the inner solar system. Other aspects of lunar site characterization and mining are discussed. Author

N93-16883*# Colorado School of Mines, Golden.
A BASELINE LUNAR MINE
Richard E. Gertsch *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 95-110 (For primary document see

N93-16875 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

A models lunar mining method is proposed that illustrates the problems to be expected in lunar mining and how they might be solved. While the method is quite feasible, it is, more importantly, a useful baseline system against which to test other, possible better, methods. Our study group proposed the slusher to stimulate discussion of how a lunar mining operation might be successfully accomplished. Critics of the slusher system were invited to propose better methods. The group noted that while nonterrestrial mining has been a vital part of past space manufacturing proposals, no one has proposed a lunar mining system in any real detail. The group considered it essential that the design of actual, workable, and specific lunar mining methods begin immediately. Based on an earlier proposal, the method is a three-drum slusher, also known as a cable-operated drag scraper. Its terrestrial application is quite limited, as it is relatively inefficient and inflexible. The method usually finds use in underwater mining from the shore and in moving small amounts of ore underground. When lunar mining scales up, the lunarized slusher will be replaced by more efficient, high-volume methods. Other aspects of lunar mining are discussed.

Author

N93-16884*# Colorado School of Mines, Golden.
ASTEROID MINING
Richard E. Gertsch *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 111-120 (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

The earliest studies of asteroid mining proposed retrieving a main belt asteroid. Because of the very long travel times to the main asteroid belt, attention has shifted to the asteroids whose orbits bring them fairly close to the Earth. In these schemes, the asteroids would be bagged and then processed during the return trip, with the asteroid itself providing the reaction mass to propel the mission homeward. A mission to one of these near-Earth asteroids would be shorter, involve less weight, and require a somewhat lower change in velocity. Since these asteroids apparently contain a wide range of potentially useful materials, our study group considered only them. The topics covered include asteroid materials and properties, asteroid mission selection, manned versus automated missions, mining in zero gravity, and a conceptual mining method.

Author

N93-16885*# Arizona Univ., Tucson.
MINING NONTERRESTRIAL RESOURCES: INFORMATION NEEDS AND RESEARCH TOPICS
Jaak J. K. Daemen *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 121-145 (For primary document see N93-16875 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

An outline of topics we need to understand better in order to apply mining technology to a nonterrestrial environment is presented. The proposed list is not intended to be complete. It aims to identify representative topics that suggest productive research. Such research will reduce the uncertainties associated with extrapolating from conventional earthbound practice to nonterrestrial applications. One objective is to propose projects that should put future discussions of nonterrestrial mining on a firmer, less speculative basis.

Author

N93-16886*# Lunar Industries, Inc., Houston, TX.
BENEFICIATION AND EXTRACTION OF NONTERESTRIAL MATERIALS, PART 2
William N. Agosto *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 146-152 (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

A review of options for processing extraterrestrial materials was dominated by industrial materials scientist who tried to identify which processes utilizing space materials could be implemented in the near term. The most practical process seem to us to be the extraction of lunar oxygen and the extraction of metals and ceramics from the residues of the reduction process. The growth of space activity will be accompanied by increased demand for liquid oxygen for each round trip to the Moon. The oxygen and the intermediary product water will be needed for the life support at the base. The reduced metals and ceramics may be considered byproducts or may develop into primary products. Some of the same processes would be directly applicable to recovery of products from asteroids. We also discussed other processes for directly utilizing asteroid metals. Some of the topics covered include beneficiation and oxygen extraction methods, metallurgy, and extraterrestrial cement.

Author

N93-16887*# Lunar Industries, Inc., Houston, TX.
LUNAR BENEFICIATION
William N. Agosto *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 153-161 (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

Natural concentrations of industrially valuable minerals are far less likely to be found on the Moon than on the Earth. But that is all the more reason for devising beneficiation processes to concentrate and extract the useful mineral components in lunar rocks and soils. As an example of a useful mineral that can be beneficiated, it has been estimated that ilmenite abundance accounts for 15 and 20 percent of the volume of the Apollo 11 and 17 basalts and 2 and 5 percent by volume in the Apollo 11 and 17 soils. Reduction of lunar ilmenite with hydrogen imported from Earth appears to one of the more practical schemes for obtaining lunar oxygen. While the reported concentrations are significant, a more highly concentrated ilmenite extract would improve the efficiency of the reduction process. The topics covered include electrostatic concentration, magnetic concentration, lunar soil sizing, and electrical sizing.

Author

N93-16888*# Aerojet TechSystems Co., Sacramento, CA.
THE ONSITE MANUFACTURE OF PROPELLANT OXYGEN FROM LUNAR RESOURCES
Sanders D. Rosenberg, Robert L. Beegle, Jr., Gerald A. Guter, Frederick E. Miller, and Michael Rothenberg *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 162-185 (For primary document see N93-16875 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

The Aerojet carbothermal process for the manufacture of oxygen from lunar materials has three essential steps: the reduction of silicate with methane to form carbon monoxide and hydrogen; the reduction of carbon monoxide with hydrogen to form methane and water; and the electrolysis of water to form hydrogen and oxygen. The reactions and the overall process are shown. It is shown with laboratory experimentation that the carbothermal process is feasible. Natural silicates can be reduced with carbon or methane. The important products are carbon monoxide, metal, and slag. The carbon monoxide can be completely reduced to form methane and water. The water can be electrolyzed to produce hydrogen and oxygen. A preliminary engineering study shows that the operation of plants using this process for the manufacture of propellant oxygen has a large economic advantage when the cost of the plant and its operation is compared to the cost of delivering oxygen from Earth.

Author

N93-16889*# Carbotek, Inc., Houston, TX.
PROCESSING LUNAR SOILS FOR OXYGEN AND OTHER MATERIALS
Christian W. Knudsen and Michael A. Gibson *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 186-194 (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

Two types of lunar materials are excellent candidates for lunar oxygen production: ilmenite and silicates such as anorthite. Both are lunar surface minable, occurring in soils, breccias, and basalts. Because silicates are considerably more abundant than ilmenite, they may be preferred as source materials. Depending on the processing method chosen for oxygen production and the feedstock material, various useful metals and bulk materials can be produced as byproducts. Available processing techniques include hydrogen reduction of ilmenite and electrochemical and chemical reductions of silicates. Processes in these categories are generally in preliminary development stages and need significant research and development support to carry them to practical deployment, particularly as a lunar-based operation. The goal of beginning lunar processing operations by 2010 requires that planning and research and development emphasize the simplest processing schemes. However, more complex schemes that now appear to present difficult technical challenges may offer more valuable metal byproducts later. While they require more time and effort to perfect, the more complex or difficult schemes may provide important processing

and product improvements with which to extend and elaborate the initial lunar processing facilities. A balanced R&D program should take this into account. The following topics are discussed: (1) ilmenite--semi-continuous process; (2) ilmenite--continuous fluid-bed reduction; (3) utilization of spent ilmenite to produce bulk materials; (4) silicates--electrochemical reduction; and (5) silicates--chemical reduction. Author

N93-16890*# Washington Univ., Saint Louis, MO.
OXYGEN FROM THE LUNAR SOIL BY MOLTEN SILICATE ELECTROLYSIS
Russell O. Colson and Larry A. Haskin *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 195-209 (For primary document see N93-16875 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

Accepting that oxygen, rather than gigantic gems or gold, is likely to make the Moon's Klondike, the extraction of oxygen from the lunar soil by molten silicate electrolysis has chosen to be investigated. Process theory and proposed lunar factory are addressed. I.I.C.

N93-16891*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
VAPOR PHASE PYROLYSIS **c25**
Wolfgang Steurer *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 210-213 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

The vapor phase pyrolysis process is designed exclusively for the lunar production of oxygen. In this concept, granulated raw material (soil) that consists almost entirely of metal oxides is vaporized and the vapor is raised to a temperature where it dissociates into suboxides and free oxygen. Rapid cooling of the dissociated vapor to a discrete temperature causes condensation of the suboxides, while the oxygen remains essentially intact and can be collected downstream. The gas flow path and flow rate are maintained at an optimum level by control of the pressure differential between the vaporization region and the oxygen collection system with the aid of the environmental vacuum. I.I.C.

N93-16892*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PLASMA SEPARATION **c75**
Wolfgang Steurer *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 214-217 p 214-217 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

This process employs a thermal plasma for the separation and production of oxygen and metals. It is a continuous process that requires no consumables and relies entirely on space resources. The almost complete absence of waste renders it relatively clean. It can be turned on or off without any undesirable side effects or residues. The prime disadvantage is its high power consumption. I.I.C.

N93-16893*# Los Alamos National Lab., NM.
PROCESSES FOR METAL EXTRACTION
David F. Bowersox *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 218-221 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

This report describes the processing of plutonium at Los Alamos National Laboratory (LANL), and operation illustrating concepts that may be applicable to the processing of lunar materials. The toxic nature of plutonium requires a highly closed system for processing lunar surface materials. I.I.C.

N93-16894*# North Texas State Univ., Denton.
BIOPROCESSING OF ORES: APPLICATION TO SPACE RESOURCES
Karl R. Johansson *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 222-241 (For primary document see N93-16875 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

The role of microorganisms in the oxidation and leaching of various ores (especially those of copper, iron, and uranium) is well known. This role is increasingly being applied by the mining, metallurgy, and sewage industries in the bioconcentration of metal ions from natural receiving waters and from waste waters. It is concluded that bioprocessing using bacteria in closed reactors may be a variable option for the recovery of metals from the lunar regolith. Obviously, considerable research must be done to define the process, specify the appropriate bacteria, determine the necessary conditions and limitations, and evaluate the overall feasibility. Author

N93-16895*# Bechtel Power Corp., Houston, TX.
PROCESSING OF METAL AND OXYGEN FROM LUNAR DEPOSITS
Constance F. Acton *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 242-258 (For primary document see N93-16875 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

On the moon, some whole rocks may be ores for abundant elements, such as oxygen, but beneficiation will be important if metallic elements are sought from raw lunar dirt. In the extraction process, a beneficiated metallic ore, such as an oxide, sulfide, carbonate, or silicate mineral, is converted to reduced metal. A variety of plausible processing technologies, which includes recovery of meteoritic iron, and processing of lunar ilmenite, are described in this report. I.I.C.

N93-16896*# Construction Technology Labs., Skokie, IL.
CONCRETE: POTENTIAL MATERIAL FOR SPACE STATION **c18**
T. D. Lin *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 259-266 (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

To build a permanent orbiting space station in the next decade is NASA's most challenging and exciting undertaking. The space station will serve as a center for a vast number of scientific products. As a potential material for the space station, reinforced concrete was studied, which has many material and structural merits for the proposed space station. Its cost-effectiveness depends on the availability of lunar materials. With such materials, only 1 percent or less of the mass of a concrete space structure would have to be transported from earth. I.I.C.

N93-16897*# Lunar Industries, Inc., Houston, TX.
LUNAR CEMENT
William N. Agosto *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 267-269 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

With the exception of water, the major oxide constituents of terrestrial cements are present at all nine lunar sites from which samples have been returned. However, with the exception of relatively rare cristobalite, the lunar oxides are not present as individual phases but are combined in silicates and in mixed oxides. Lime (CaO) is most abundant on the Moon in the plagioclase ($CaAl_2Si_2O_8$) of highland anorthosites. It may be possible to enrich the lime content of anorthite to levels like those of Portland cement by pyrolyzing it with lunar-derived phosphate. The phosphate consumed in such a reaction can be regenerated by reacting the phosphorus product with lunar augite pyroxenes at elevated temperatures. Other possible sources of lunar phosphate and other oxides are discussed. Author

N93-16898*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MANUFACTURING AND FABRICATION, PART 3
Sankar Sastri (New York City Technical Coll., Brooklyn, NY.), Michael B. Duke, and Larry A. Haskin (Washington Univ., Saint Louis, MO.) *In its* Space Resources. Volume 3: Materials 1992 p 270-280 (For primary document see N93-16875 05-91)
Avail: CASI HC A03/MF A03; SOD HC; 4 functional color pages

The accessibility of material and energy off the Earth and the leverage that these nonterrestrial resources can exert on the space transportation system are important influences on the long-term goal of exploring the solar system. Research on separation of lunar materials and manufacturing of useful products from them is in its infancy. A few possible processes and products are described in this report. Specific attention is given to oxygen, metal, and silicate products. Author

N93-16899*# New York City Technical Coll., Brooklyn, NY.
IRON AND ALLOYS OF IRON
Sankar Sastri *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 281-290 (For primary document see

N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

All lunar soil contains iron in the metallic form, mostly as an iron-nickel alloy in concentrations of a few tenths of 1 percent. Some of this free iron can be easily separated by magnetic means. It is estimated that the magnetic separation of 100,000 tons of lunar soil would yield 150-200 tons of iron. Agglutinates contain metallic iron which could be extracted by melting and made into powder metallurgy products. The characteristics and potential uses of the pure-iron and iron-alloy lunar products are discussed. Processes for working iron that might be used in a nonterrestrial facility are also addressed. Author

N93-16900*# Washington Univ., Saint Louis, MO.
GLASS AND CERAMICS
Larry A. Haskin *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 291-294 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

A variety of glasses and ceramics can be produced from bulk lunar materials or from separated components. Glassy products include sintered regolith, quenched molten basalt, and transparent glass formed from fused plagioclase. No research has been carried out on lunar material or close simulants, so properties are not known in detail; however, common glass technologies such as molding and spinning seem feasible. Possible methods for producing glass and ceramic materials are discussed along with some potential uses of the resulting products. Author

N93-16901*# Portland Cement Association, Skokie, IL.
CEMENT AND CONCRETE
Gene Corley and Larry A. Haskin (Washington Univ., Saint Louis, MO.) *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 295-297 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

To produce lunar cement, high-temperature processing will be required. It may be possible to make calcium-rich silicate and aluminate for cement by solar heating of lunar pyroxene and feldspar, or chemical treatment may be required to enrich the calcium and aluminum in lunar soil. The effects of magnesium and ferrous iron present in the starting materials and products would need to be evaluated. So would the problems of grinding to produce cement, mixing, forming in vacuo and low gravity, and minimizing water loss. Author

N93-16902*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
APPLICATION OF MANUFACTURED PRODUCTS
Sankar Sastri (New York City Technical Coll., Brooklyn, NY.) and Michael B. Duke *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 298-306 (For primary document see N93-16875 05-91)
Avail: CASI HC A02/MF A03; SOD HC; 4 functional color pages

A wide range of products can be manufactured from the following materials: (1) lunar regolith or basalt; (2) regolith or rock beneficiated to concentrate plagioclase or other minerals; (3) iron, extracted from lunar soil or rocks by various means; (4) naturally occurring or easily obtained materials that have cementitious properties; and (5) byproducts of the above materials. Among the products that can be produced from these materials are the following: beams; plates and sheets; transparent plates (windows); bricks and blocks; pipes and tubes; low-density materials (foams); fiber, wire, and cables; foils and reflective coatings; hermetic seals (coatings); and formed objects. In addition to oxygen, which can be obtained by several processes, either from unbeneficiated regolith or by reduction of concentrated ilmenite, these materials make the simplest requirements of the lunar resource extraction system. A thorough analysis of the impact of these simplest products on the economics of space operations is not possible at this point. Research is necessary both to define optimum techniques and adapt them to space and to determine the probable market for the products so that the priority of various processes can be assessed. Discussions of the following products are presented: aerobraking heat shields; pressurized habitats; lunar photovoltaic farms; and agricultural systems. Author

N93-16903*# Los Alamos National Lab., NM.
MICROWAVE HEATING OF LUNAR MATERIALS. APPENDIX A
Thomas T. Meek *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 307-311 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

Microwave heating of nonmetallic inorganic material has been of interest for many years. Von Hippel in the late 1940's and early 1950's investigated how microwave radiation up to 10 GHz couples to various insulator materials. Perhaps the most work has been done by Wayne Tinga at the University of Edmonton. Most of the work to date has been done at the two frequency bands allowed in industrial use (0.915 GHz and 2.45 GHz). However some work has recently been carried out at 28 GHz and 60 GHz. Work done in this area at Los Alamos National Laboratory is discussed. Author

N93-16904*# Portland Cement Association, Skokie, IL.
PROPERTIES AND USES OF CONCRETE, APPENDIX B **c27**
Gene Corley *In* NASA. Johnson Space Center, Space Resources. Volume 3: Materials 1992 p 312-316 (For primary document see N93-16875 05-91)
Avail: CASI HC A01/MF A03; SOD HC; 4 functional color pages

Concretes that can now be formed have properties which may make them valuable for lunar or space construction. These properties include high compressive strength, good flexural strength (when reinforced), and favorable responses to temperature extremes (even increased strength at low temperatures). These and other properties of concrete are discussed. Author

N93-16905*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE RESOURCES. VOLUME 2: ENERGY, POWER, AND TRANSPORT
Mary Fae McKay, ed., David S. McKay, ed., and Michael B. Duke, ed. 1992 184 p Original contains color illustrations
(NASA-SP-509-Vol-2; S-689-Vol-2; NAS 1.21:509-Vol-2; ISBN-0-16-038062-6; LC-92-4468) Avail: CASI HC A09/MF A02; SOD HC; 4 functional color pages

This volume of the Space Resources report covers a number of technical and policy issues concerning the energy and power to carry out advanced space missions and the means of transportation to get to the sites of those missions. Discussed in the first half of this volume are the technologies which might be used to provide power and a variety of ways to convert power from one form to another, store it, move it wherever it is needed, and use it. In the second half of this volume, various kinds of transportation, including both interplanetary and surface systems, are discussed. For individual titles, see N93-16906 through N93-16917.

N93-16906*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
POWER SYSTEM REQUIREMENTS
Edmund J. Conway *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 4-11 (For primary document see N93-16905 05-91)
Avail: CASI HC A02/MF A02; SOD HC; 4 functional color pages

An overview of electrical power requirements for each mission of a baseline and alternate plan for space activities in the 1990-2035 timeframe is presented. The specific missions included low earth orbit (LEO), geosynchronous earth orbit (GEO), lunar, Mars, and asteroid related projects. Author

N93-16907*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TECHNOLOGIES **c44**
Henry W. Brandhorst, Jr. *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 12-32 (For primary document see N93-16905 05-91)
Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

Energy technologies to meet the power requirements of future space missions are reviewed. Photovoltaic, solar dynamic, and solar thermal technologies are discussed along with techniques for energy storage and power management and distribution. Author

N93-16908*# National Aeronautics and Space Administration, Washington, DC.

NUCLEAR ENERGY TECHNOLOGY **c73**

David Buden *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 32-56 (For primary document see N93-16905 05-91)

Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

An overview of space nuclear energy technologies is presented. The development and characteristics of radioisotope thermoelectric generators (RTG's) and space nuclear power reactors are discussed. In addition, the policy and issues related to public safety and the use of nuclear power sources in space are addressed. Author

N93-16909*# Washington Univ., Seattle.

THERMAL MANAGEMENT IN SPACE **c20**

Abraham Hertzberg *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 57-69 (For primary document see N93-16905 05-91)

Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

Thermal management for space-based and lunar- or asteroid-based power generating systems is discussed. Heat pipes, pump loop systems, and advanced radiator concepts are addressed. Author

N93-16910*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LASER POWER TRANSMISSION **c36**

Edmund J. Conway *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 70-81 Original contains color illustrations (For primary document see N93-16905 05-91)

Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

An overview of previous studies related to laser power transmission is presented. Particular attention is given to the use of solar pumped lasers for space power applications. Three general laser mechanisms are addressed: photodissociation lasing driven by sunlight, photoexcitation lasing driven directly by sunlight, and photoexcitation lasing driven by thermal radiation. Author

N93-16911*# Clemson Univ., SC.

TRANSPORT: INTRODUCTION

William Lewis and Sanders D. Rosenberg (Aerojet TechSystems Co., Sacramento, CA.) *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 82-96 (For primary document see N93-16905 05-91)

Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

Space transportation requirements for the NASA baseline scenario for future space missions are discussed. Spacecraft/propulsion technologies required for surface-to-orbit, orbit-to-orbit, and surface (lunar) transportation are addressed. Author

N93-16912*# General Dynamics Corp., San Diego, CA.

UTILIZATION OF SPACE RESOURCES IN THE SPACE TRANSPORTATION SYSTEM

Michael C. Simon *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 97-108 (For primary document see N93-16905 05-91)

Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

Utilization of space resources (i.e., raw materials obtained from nonterrestrial sources) has often been cited as a prerequisite for large-scale industrialization and habitation of space. While transportation of extremely large quantities of material from Earth would be costly and potentially destructive to our environment, vast quantities of usable resources might be derived from the Moon, the asteroids, and other celestial objects in a cost-effective and environmentally benign manner. The primary purpose of the parametric cost model developed as part of this study is to identify the factors that have the greatest influence on the economics of space resource utilization. In the near term, this information can be used to devise strategies for technology development so that capabilities developed will produce cost-effective results. Author

N93-16913*# California Univ., San Diego, La Jolla. California Space Inst.

ALUMINUM-FUELED ROCKETS FOR THE SPACE TRANSPORTATION SYSTEM **c20**

Andrew Hall Cutler *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 109-116 (For primary document see N93-16905 05-91)

Avail: CASI HC A02/MF A02; SOD HC; 4 functional color pages

Aluminum-fueled engines, used to propel orbital transfer vehicles (OTV's), offer benefits to the Space Transportation System (STS) if scrap aluminum can be scavenged at a reasonable cost. Aluminum scavenged from Space Shuttle external tanks could replace propellants hauled from Earth, thus allowing more payloads to be sent to their final destinations at the same Shuttle launch rate. To allow OTV use of aluminum fuel, two new items would be required: a facility to reprocess aluminum from external tanks and an engine for the OTV which could burn aluminum. Design of the orbital transfer vehicle would have to differ substantially from current concepts for it to carry and use the aluminum fuel. The aluminum reprocessing facility would probably have a mass of under 15 metric tons and would probably cost less that $200,000,000. Development of an aluminum-burning engine would no doubt be extremely expensive (1 to 2 billion dollars), but this amount would be adequately repaid by increased STS throughput. Engine production cost is difficult to estimate, but even an extremely high cost (e.g., $250,000,000 per engine) would not significantly increase orbit-raising expenses. Author

N93-16914*# Electromagnetic Launch Research, Inc., Cambridge, MA.

ELECTROMAGNETIC LAUNCH OF LUNAR MATERIAL

William R. Snow and Henry H. Kolm *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 117-135 (For primary document see N93-16905 05-91)

Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

Lunar soil can become a source of relatively inexpensive oxygen propellant for vehicles going from low Earth orbit (LEO) to geosynchronous Earth orbit (GEO) and beyond. This lunar oxygen could replace the oxygen propellant that, in current plans for these missions, is launched from the Earth's surface and amounts to approximately 75 percent of the total mass. The reason for considering the use of oxygen produced on the Moon is that the cost for the energy needed to transport things from the lunar surface to LEO is approximately 5 percent the cost from the surface of the Earth to LEO. Electromagnetic launchers, in particular the superconducting quenchgun, provide a method of getting this lunar oxygen off the lunar surface at minimal cost. This cost savings comes from the fact that the superconducting quenchgun gets its launch energy from locally supplied, solar- or nuclear-generated electrical power. We present a preliminary design to show the main features and components of a lunar-based superconducting quenchgun for use in launching 1-ton containers of liquid oxygen, one every 2 hours. At this rate, nearly 4400 tons of liquid oxygen would be launched into low lunar orbit in a year. Author

N93-16915*# California Univ., San Diego, La Jolla. California Space Inst.

TETHERS **c18**

Andrew Hall Cutler and Joseph A. Carroll *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 136-150 (For primary document see N93-16905 05-91)

Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

A tether of sufficient strength, capable of being lengthened or shortened and having appropriate apparatuses for capturing and releasing bodies at its ends, may be useful in propulsion applications. For example, a tether could allow rendezvous between spacecraft in substantially different orbits without using propellant. A tether could also allow co-orbiting spacecraft to exchange momentum and separate. Thus, a reentering spacecraft (such as the Shuttle) could give its momentum to one remaining on orbit (such as the space station). Similarly, a tether facility could gain momentum from a high I(sub sp)/low thrust mechanism (which could be an electrodynamics tether) and transfer than momentum by means of a tether to payloads headed for many different orbits. Such a facility would, in effect, combine high I(sub sp) with high thrust, although only briefly. An electrodynamic tether could propel a satellite from its launch inclination to a higher or lower inclination. Tethers could also allow samples to be taken from bodies such as the Moon. Three types of tether operations are illustrated. The

following topics are discussed: (1) tether characteristics; (2) tether propulsion methods--basics, via momentum transfer, and electrodynamic tether propulsion; and (3) their use in planetary exploration. Author

N93-16916*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ELECTRIC PROPULSION **c20**
Philip W. Garrison *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 151-159 (For primary document see N93-16905 05-91)
Avail: CASI HC A02/MF A02; SOD HC; 4 functional color pages

Electric propulsion (EP) is an attractive option for unmanned orbital transfer vehicles (OTV's). Vehicles with solar electric propulsion (SEP) could be used routinely to transport cargo between nodes in Earth, lunar, and Mars orbit. Electric propulsion systems are low-thrust, high-specific-impulse systems with fuel efficiencies 2 to 10 times the efficiencies of systems using chemical propellants. The payoff for this performance can be high, since a principal cost for a space transportation system is that of launching to low Earth orbit (LEO) the propellant required for operations between LEO and other nodes. Several aspects of electric propulsion, including candidate systems and the impact of using nonterrestrial materials, are discussed. Author

N93-16917*# Rockwell International Corp., Canoga Park, CA.
BEAMED ENERGY PROPULSION **c20**
James M. Shoji *In* NASA. Johnson Space Center, Space Resources. Volume 2: Energy, Power, and Transport 1992 p 160-171 (For primary document see N93-16905 05-91)
Avail: CASI HC A03/MF A02; SOD HC; 4 functional color pages

Beamed energy concepts offer an alternative for an advanced propulsion system. The use of a remote power source reduces the weight of the propulsion system in flight and this, combined with the high performance, provides significant payload gains. Within the context of this study's baseline scenario, two beamed energy propulsion concepts are potentially attractive: solar thermal propulsion and laser thermal propulsion. The conceived beamed energy propulsion devices generally provide low thrust (tens of pounds to hundreds of pounds); therefore, they are typically suggested for cargo transportation. For the baseline scenario, these propulsion system can provide propulsion between the following nodes: (1) low Earth orbit to geosynchronous Earth orbit; (2) low Earth orbit to low lunar orbit; (3) low lunar orbit to low Mars orbit--only solar thermal; and (4) lunar surface to low lunar orbit--only laser thermal. Author

N93-17194# Los Alamos National Lab., NM.
THE PROSPECTOR MISSION
B. Edwards, C. Pieters (Brown Univ., Providence, RI.), M. Ulmer (Northwestern Univ., Evanston, IL.), and C. Henrikson (Ball Aerospace Systems Div., Boulder, CO.) Sep. 1992 12 p Presented at the Discovery Program Workshop, San Jaua Capistrano, CA, 16 Nov. 1992
(Contract W-7405-eng-36)
(DE93-000656; LA-UR-92-3049; CONF-9211107-1) Avail: CASI HC A03/MF A01

The Prospector mission combines high resolution visual/near-infrared imaging spectroscopy with moderately high resolution K- and L-line x-ray fluorescence mapping. These combined capabilities can be used to map the composition of virtually all solar-system objects, ranging from those that lack atmospheres (Mercury, the Moon, asteroids, and martian satellites) to the upper atmosphere of Venus. For the purpose of mission definition and development, we have focused on a mapping mission to the moons of Mars, specifically Phobos, which is an easily accessible small body of the solar system and has long been an object of intense speculation. Phobos is variously interpreted as a captured asteroid, a captured but disrupted basaltic achondrite body with anomalously low density, a comet nucleus, a body of reassembled Mars material ejected into orbit during a large impact event, a body of unknown origin but covered by an accumulation of cosmic dust and/or material ejected from Deimos, or none of the above. Multispectral observations of Phobos by instruments on the Phobos 2 Spacecraft indicate that the surface of the moon is spectrally heterogeneous, with at least four units based on extended visible color. Distribution of color ratio units are most likely caused by compositional heterogeneity and surficial processes. The composition and structure of Phobos remains a stimulating scientific question, but Phobos is much more than a cipher among planetary phenomena. The low delta(V) requirements for missions to Phobos make it readily accessible-much more so than the martian surface. The low orbital height of Phobos makes it an attractive platform for staging Mars observation and exploration. Furthermore, the possible chondritic nature of Phobos may provide a valuable reservoir of extractable H, C, N, O, and S. DOE

N93-17233*# Lunar and Planetary Inst., Houston, TX.
JOINT WORKSHOP ON NEW TECHNOLOGIES FOR LUNAR RESOURCE ASSESSMENT Abstract Only
Rick C. Elphic, ed. and David S. McKay, ed. 1992 64 p Workshop held in Santa Fe, NM, 6-7 Apr. 1992; Sponsored by NASA. Johnson Space Center, LANL, and LPI
(Contract NASw-4574)
(NASA-CR-191918; NAS 1.26:191918; LPI-TR-92-06) Avail: CASI HC A04/MF A01

The workshop included talks on NASA's and DOE's role in Space Exploration Initiative, lunar geology, lunar resources, the strategy for the first lunar outpost, and an industry perspective on lunar resources. The sessions focused on four major aspects of lunar resource assessment: (1) Earth-based remote sensing of the Moon; (2) lunar orbital remote sensing; (3) lunar lander and roving investigations; and (4) geophysical and engineering consideration. The workshop ended with a spirited discussion of a number of issues related to resource assessment. For individual titles, see N93-17234 through N93-17270.

N93-17234*# Schlumberger-Doll Research, Ridgefield, CT.
APPLICATION OF NUCLEAR WELL LOGGING TECHNIQUES TO LUNAR RESOURCE ASSESSMENT Abstract Only
P. Albats, J. Groves, J. Schweitzer (California Inst. of Tech., Pasadena.), and T. Tombrello *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 9-10 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

The use of neutron and gamma ray measurements for the analysis of material composition has become well established in the last 40 years. Schlumberger has pioneered the use of this technology for logging wells drilled to produce oil and gas, and for this purpose has developed neutron generators that allow measurements to be made in deep (5000 m) boreholes under adverse conditions. We also make ruggedized neutron and gamma ray detector packages that can be used to make reliable measurements on the drill collar of a rotating drill string while the well is being drilled, where the conditions are severe. Modern nuclear methods used in logging measure rock formation parameters like bulk density and porosity, fluid composition, and element abundances by weight including hydrogen concentration. The measurements are made with high precision and accuracy. These devices (well logging sondes) share many of the design criteria required for remote sensing in space; they must be small, light, rugged, and able to perform reliably under adverse conditions. We see a role for the adaptation of this technology to lunar or planetary resource assessment missions. Author

N93-17235*# California Univ., Berkeley. Lawrence Berkeley Lab.
GEOPHYSICAL METHODS: AN OVERVIEW Abstract Only
A. Becker, N. E. Goldstein, K. H. Lee, E. L. Majer, H. F. Morrison, and L. Myer *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 10-11 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Geophysics is expected to have a major role in lunar resource assessment when manned systems return to the Moon. Geophysical measurements made from a lunar rover will contribute to a number of key studies: estimating regolith thickness, detection of possible large-diameter lava tubes within maria basalts, detection of possible subsurface ice in polar regions, detection of conductive minerals that formed directly from a melt (orthomagmatic sulfides of Cu, Ni, Co), and mapping lunar geology beneath the regolith. The techniques that can be used are dictated both by objectives and by our abilities to adapt current technology to lunar conditions. Instrument size, weight, power requirements, and freedom from orientation errors are factors we have considered. Among the geophysical methods we believe to be appropriate for a lunar resource assessment are magnetics, including gradiometry, time-domain magnetic induction, ground-penetrating radar, seismic reflection, and gravimetry. Author

N93-17236*# Los Alamos National Lab., NM.
TOPLEX: TELEOPERATED LUNAR EXPLORER. INSTRUMENTS AND OPERATIONAL CONCEPTS FOR AN UNMANNED LUNAR ROVER Abstract Only
James D. Blacic *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 11-12 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

A Teleoperated Lunar Explorer, or TOPLEX, consisting of a lunar lander payload in which a small, instrument-carrying lunar surface rover is robotically landed and teleoperated from Earth to perform extended lunar geoscience and resource evaluation traverses is proposed. The rover vehicle would mass about 100 kg and carry approximately 100 kg of analytic instruments. Four instruments are envisioned: (1) a Laser-Induced Breakdown Spectrometer (LIBS) for geochemical analysis at ranges up to 100 m, capable of operating in three different modes; (2) a combined x-ray fluorescence and x-ray diffraction (XRF/XRD) instrument for elemental and mineralogic analysis of acquired samples; (3) a mass spectrometer system for stepwise heating analysis of gases released from acquired samples; and (4) a geophysical instrument package for subsurface mapping of structures such as lava tubes. Author

N93-17237*# Texas A&M Univ., College Station. Dept. of Civil Engineering.
DRILLING AND DIGGING TECHNIQUES FOR THE EARLY LUNAR OUTPOST Abstract Only
Walter W. Boles *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 12-14 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

The theme of this workshop is lunar resource assessment. Topics include identification, quantification, and location of useful elements on and below the lunar surface. The objective of this paper is to look at another side of the issue--how to remove soil from the stiff lunar-soil matrix once useful deposits are located. The goal of this paper is to cause those who think that digging or excavating on the Moon is a trivial problem to rethink the reasons for their opinions. Another goal is to encourage them to view total reliance upon terrestrial heuristics with suspicion. This paper will focus primarily upon digging. Author

N93-17238*# Sandia National Labs., Albuquerque, NM.
SHOCK-TREATED LUNAR SOIL SIMULANT: PRELIMINARY ASSESSMENT AS A CONSTRUCTION MATERIAL Abstract Only
Mark B. Boslough, Leonhard E. Bernold (North Carolina State Univ., Raleigh.), and Yasuyuki Horie (North Carolina State Univ., Raleigh.) *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 14-15 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

In an effort to examine the feasibility of applying dynamic compaction techniques to fabricate construction materials from lunar regolith, preliminary explosive shock-loading experiments on lunar soil simulants were carried out. Analysis of our shock-treated samples suggests that binding additives, such as metallic aluminum powder, may provide the necessary characteristics to fabricate a strong and durable building material (lunar adobe) that takes advantage of a cheap base material available in abundance: lunar regolith. L.R.R.

N93-17239*# Arizona Univ., Tucson.
A LUNAR PENETRATOR TO DETERMINE SOLAR-WIND-IMPLANTED RESOURCES AT DEPTH IN THE LUNAR REGOLITH
W. Boynton, W. Feldman (Los Alamos National Lab., NM.), and T. Swindle *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 15-16 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Several volatiles implanted into the lunar regolith by the solar wind are potentially important lunar resources. He-3 might be mined as a fuel for lunar nuclear fusion reactors. Even if the mining of He-3 turns out not to be feasible, several other elements commonly implanted by the solar wind (H,C, and N) could be important for life support and for propellant or fuel production for lunar bases. A simple penetrator-borne instrument package to measure the abundance of H at depth is proposed. Since solar-wind-implanted volatiles tend to correlate with one another, this can be used to estimate global inventories and to design extraction strategies for all of these species. Author

N93-17240*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ESTIMATING LUNAR PYROCLASTIC DEPOSIT DEPTH FROM IMAGING RADAR DATA: APPLICATIONS TO LUNAR RESOURCE ASSESSMENT Abstract Only
B. A. Campbell (Hawaii Univ., Honolulu.), N. J. Stacy (Cornell Univ., Ithaca, NY.), D. B. Campbell (Cornell Univ., Ithaca, NY.), S. H. Zisk (Hawaii Univ., Honolulu.), T. W. Thompson, and B. R. Hawke (Hawaii Univ., Honolulu.) *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 16-17 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Lunar pyroclastic deposits represent one of the primary anticipated sources of raw materials for future human settlements. These deposits are fine-grained volcanic debris layers produced by explosive volcanism contemporaneous with the early stage of mare infilling. There are several large regional pyroclastic units on the Moon (for example, the Aristarchus Plateau, Rima Bode, and Sulpicius Gallus formations), and numerous localized examples, which often occur as dark-halo deposits around endogenic craters (such as in the floor of Alphonsus Crater). Several regional pyroclastic deposits were studied with spectral reflectance techniques: the Aristarchus Plateau materials were found to be a relatively homogeneous blanket of iron-rich glasses. One such deposit was sampled at the Apollo 17 landing site, and was found to have ferrous oxide and titanium dioxide contents of 12 percent and 5 percent, respectively. While the areal extent of these deposits is relatively well defined from orbital photographs, their depths have been constrained only by a few studies of partially filled impact craters and by imaging radar data. A model for radar backscatter from mantled units applicable to both 70-cm and 12.6-cm wavelength radar data is presented. Depth estimates from such radar observations may be useful in planning future utilization of lunar pyroclastic deposits. Author

N93-17241*# POD Associates, Inc., Albuquerque, NM.
A GROUND-BASED SEARCH FOR LUNAR RESOURCES USING HIGH-RESOLUTION IMAGING IN THE INFRARED Abstract Only
C. R. Coombs and T. S. McKechnie *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 17-19 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

When humans return to the Moon, lunar resources will play an important role in the successful deployment and maintenance of the lunar base. Previous studies have illustrated the abundance of resource materials available on the surface of the Moon, as well as their ready accessibility. Particularly worth considering are the lunar regional (2,000-30,000 sq km) pyroclastic deposits scattered about the lunar nearside. These 30-50-m-thick deposits are composed of fine-grained unconsolidated titanium- and iron-rich mafic glasses and may be used as bulk feedstock for the beneficiation of oxygen, iron, titanium, sulfur, and other solar wind gases, or simply used as is for construction and shielding purposes. A groundbased observing survey of the resource-rich regions on the lunar nearside using a new imaging technique designed to obtain much higher resolution images, and more precise compositional analyses than previously obtainable is proposed. Author

N93-17242*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A REMOTE LASER MASS SPECTROMETER FOR LUNAR RESOURCE ASSESSMENT Abstract Only
R. J. DeYoung and M. D. Williams *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 19-20 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

The use of lasers as a source of excitation for surface mass spectroscopy has been investigated for some time. Since the laser can be focused to a small spot with intensity, it can vaporize and accelerate atoms of material. Using this phenomenon with a time-of-flight mass spectrometer allows a surface elemental mass analysis of a small region with each laser pulse.

While the technique has been well developed for Earth applications, space applications are less developed. NASA Langley recently began a research program to investigate the use of a laser to create ions from the lunar surface and to analyze the ions at an orbiting spacecraft. A multijoule, Q-switched Nd:YAG laser would be focused to a small spot on the lunar surface, creating a dense plasma. This plasma would eject high-energy ions, as well as neutrals, electrons, and photons. An experiment is being set up to determine the characteristics of such a laser mass spectrometer at long flight distances. This experiment will determine the character of a future flight instrument for lunar resource assessment. Author

N93-17243*# Chicago Univ., IL. Enrico Fermi Inst.
AN ALPHA-p-x ANALYTICAL INSTRUMENT FOR LUNAR RESOURCE INVESTIGATIONS Abstract Only
T. E. Economou and A. L. Turkevich *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 20-22 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

An instrument using alpha backscattering, alpha-proton nuclear reactions, and x-ray production by alpha particles and other auxiliary sources can be used on lunar landers to provide detailed analytical information concerning the lunar surface material. This information is important scientifically and can be the basis for utilizing efficiently lunar resources to build lunar colonies in the future. This alpha particle instrument uses radioactive isotopes, silicon detectors for the alpha and proton modes, and mercuric iodide detectors operating at room temperature for the x-ray mode. The alpha and proton modes of the instrument can provide an analysis for all elements (except hydrogen) present in amounts greater than about 1 percent by atom. These modes have excellent sensitivity and accuracy for the lighter elements, in particular, directly determining the amount of oxygen in the lunar soil. This is an element of paramount significance for the lunar resource mission. The x-ray mode makes possible a determination of Ti, Fe, and other important metals with even greater accuracy. In general, the x-ray mode provides increased sensitivity for heavier elements, in many cases achieving a sensitivity of several hundred ppm. Author

N93-17244*# Los Alamos National Lab., NM.
HIGH-RESOLUTION ELEMENTAL MAPPING OF THE LUNAR SURFACE Abstract Only
Bradley C. Edwards, Frank Ameduri, Jeffrey J. Bloch, William C. Priedhorsky, Diane Roussel-Dupre, and Barham W. Smith *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 22 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

New instruments and missions are being proposed to study the lunar surface as a result of the resurgence of interest in returning to the Moon. One instrument recently proposed is similar in concept to the x-ray fluorescence detectors flown on Apollo, but utilizes fluorescence from the L- and M-shells rather than the K-shell. This soft X-Ray Flourescence Imager (XRFI) is discussed. Author

N93-17245*# Los Alamos National Lab., NM.
LUNAR AND ASTEROID COMPOSITION USING A REMOTE SECONDARY ION MASS SPECTROMETER Abstract Only
R. C. Elphic, H. O. Funsten, B. L. Barraclough, D. J. McComas, and J. E. Nordholt *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 22-24 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Laboratory experiments simulating solar wind sputtering of lunar surface materials have shown that solar wind protons sputter secondary ions in sufficient numbers to be measured from low-altitude lunar orbit. Secondary ions of Na, Mg, Al, Si, K, Ca, Mn, Ti, and Fe have been observed sputtered from sample simulants of mare and highland soils. While solar wind ions are hundreds of times less efficient than those used in standard secondary ion mass spectrometry, secondary ion fluxes expected at the Moon under normal solar wind conditions range from approximately 10 to greater than 10(exp 4) ions cm(sup -2)s(sup -1), depending on species. These secondary ion fluxes depend both on concentration in the soil and on probability of ionization; yields of easily ionized elements such as K and Na are relatively much greater than those for the more electronegative elements and compounds. Once these ions leave the surface, they are subject to acceleration by local electric and magnetic fields. For typical solar wind conditions, secondary ions can be accelerated to an orbital observing location. The same is true for atmospheric atoms and molecules that are photoionized by solar EUV. The instrument to detect, identify, and map secondary ions sputtered from the lunar surface and photoions arising from the tenuous atmosphere is discussed. Author

N93-17246*# Bechtel Corp., San Francisco, CA.
LUNAR RESOURCE ASSESSMENT: AN INDUSTRY PERSPECTIVE Abstract Only
S. C. Feldman, B. H. Altenberg, and H. A. Franklin *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 24-25 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

The goals of the U.S. space program are to return to the Moon, establish a base, and continue onward to Mars. To accomplish this in a relatively short time frame and to avoid the high costs of transporting materials from the Earth, resources on the Moon will need to be mined. Oxygen will be one of the most important resources, to be used as a rocket propellant and for life support. Ilmenite and lunar regolith have both been considered as ores for the production of oxygen. Resource production on the Moon will be a very important part of the U.S. space program. To produce resources we must explore to identify the location of ore or feedback and calculate the surface and underground reserves. Preliminary resource production tests will provide the information that can be used in final plant design. Bechtel Corporation's experience in terrestrial engineering and construction has led to an interest in lunar resource assessment leading to the construction of production facilities on the Moon. There is an intimate link between adequate resource assessment to define feedstock quantity and quality, material processing requirements, and the successful production of lunar oxygen. Although lunar resource assessment is often viewed as a research process, the engineering and production aspects are very important to consider. Resource production often requires the acquisition of different types, scales, or resolutions of data than that needed for research, and it is needed early in the exploration process. An adequate assessment of the grade, areal extent, and depth distribution of the resources is a prerequisite to mining. The need for a satisfactory resource exploration program using remote sensing techniques, field sampling, and chemical and physical analysis is emphasized. These data can be used to define the ore for oxygen production and the mining, processing facilities, and equipment required. Author

N93-17247*# Brown Univ., Providence, RI. Dept. of Geological Sciences.
LUNAR RESOURCES USING MODERATE SPECTRAL RESOLUTION VISIBLE AND NEAR-INFRARED SPECTROSCOPY: Al/Si AND SOIL MATURITY Abstract Only
Erich M. Fischer, Carle M. Pieters, and James W. Head *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 25-28 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Modern visible and near-infrared detectors are critically important for the accurate identification and relative abundance measurement of lunar minerals; however, even a very small number of well-placed visible and near-infrared bandpass channels provide a significant amount of general information about crucial lunar resources. The Galileo Solid State Imaging system (SSI) multispectral data are an important example of this. Al/Si and soil maturity will be discussed as examples of significant general lunar resource information that can be gleaned from moderate spectral resolution visible and near-infrared data with relative ease. Because quantitative-albedo data are necessary for these kinds of analyses, data such as those obtained by Galileo SSI are critical. SSI obtained synoptic digital multispectral image data for both the nearside and farside of the Moon during the first Galileo Earth-Moon encounter in December 1990. The data consist of images through seven filters with bandpasses ranging from 0.40 microns in the ultraviolet to 0.99 microns in the near-infrared. Although these data are of moderate spectral resolution, they still provide information for the following lunar resources: (1) titanium content of mature mare soils based upon the 0.40/0.56-micron (UV/VIS) ratio; (2) mafic mineral abundance based upon

the 0.76/0.99-micron ratio; and (3) the maturity or exposure age of the soils based upon the 0.56-0.76-micron continuum and the 0.76/0.99-micron ratio. Within constraints, these moderate spectral resolution visible and near-infrared reflectance data can also provide elemental information such as Al/Si for mature highland soils. Author

N93-17248*# Lockheed Engineering and Sciences Co., Houston, TX.
RADON AS A TRACER FOR LUNAR VOLATILES Abstract Only
Larry Jay Friesen *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 28-29 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Radon and its decay product polonium can be used as tracers to search for lunar volatiles. One effective technique to look for them would be by using alpha-particle spectrometers from lunar orbit. Alpha spectrometers were flown in the Apollo Service Modules during the Apollo 15 and 16 missions, and did observe Rn-222 and its decay product Po-210 on the lunar surface from orbit. This demonstrates that radon and polonium can be observed from orbit; what must next be shown is that such observations can reveal something about the locations of volatiles on the Moon. Author

N93-17249*# Nevada Univ., Reno. Mackay School of Mines.
ECONOMIC GEOLOGY OF THE MOON: SOME CONSIDERATIONS Abstract Only
Stephen L. Gillett *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 29-30 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Supporting any but the smallest lunar facility will require indigenous resources due to the extremely high cost of bringing material from Earth. The Moon has also attracted interest as a resource base to help support near-Earth space activities, because of the potential lower cost once the necessary infrastructure has been amortized. Obviously, initial lunar products will be high-volume, bulk commodities, as they are the only ones for which the economics of lunar production are conceivably attractive. Certain rarer elements, such as the halogens, C, and H, would also be extremely useful (for propellant, life support, and/or reagents), and indeed local sources of such elements would vastly improve the economics of lunar resource extraction. The economic geology of the Moon is discussed. Author

N93-17250*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE TARGET: H2O ON THE MOON Abstract Only
J. Green, J. Negusde Wys (California Univ., Berkeley.), and A. Zuppero (California Univ., Berkeley.) *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 30-31 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

The importance of H2O on the lunar surface has long been identified as a high priority for the existence of a human colony for mining activities and, more recently, for space fuel. Using the Earth as an analog, volcanic activity would suggest the generation of water during lunar history. Evidence of volcanism is found not only in present lunar morphology, but in over 400 locations of lunar transient events cataloged by Middlehurst and Kuiper in the 1960's. These events consisted of sightings since early history of vapor emissions and bright spots or flares. Later infrared scanning by Saari and Shorthill showed 'hot spots', many of which coincided with transient event sites. Many of the locations of Middlehurst and Kuiper were the sites of repeat events, leading to the conclusion that these were possibly volcanic in nature. The detection and use of H2O from the lunar surface is discussed. Author

N93-17251*# Arizona Univ., Tucson. Lunar and Planetary Laboratory.
LUNAR MAGNETIC FIELDS: IMPLICATIONS FOR RESOURCE UTILIZATION Abstract Only
L. L. Hood *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 31-32 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

It is well known that solar-wind-implanted hydrogen and helium-3 in lunar soils are potentially usable resources for future manned activities. For economical mining of these implanted gases, it is desirable that relative concentrations exceed that of typical soils. It has previously been noted that the monthly variation of solar wind flux on the surface due to lunar immersion in the geomagnetic tail may have measurable consequences for resource utilization. It is pointed out that, for a constant external flux, locally strong lunar crustal magnetic fields will exert the dominant influence on solar wind volatile implantation rates. In particular, the strongest lunar crustal magnetic fields will both deflect and focus incident ions in local regions leading to local enhancements of the incident ion flux. Thus, the most economical sites for extraction of solar-wind-implanted volatiles may be within or adjacent to strong crustal magnetic fields. In addition, solar wind ion deflection by crustal magnetic fields must be considered in evaluating the issue of whether remnant cometary ice or water-bearing minerals have survived in permanently shadowed regions near the lunar poles. This is because sputter erosion of water ice by solar wind ions has been suggested to be an important ice loss mechanism within permanently shadowed regions. Thus, permanently shadowed regions that are also shielded from the solar wind by locally strong crustal fields could be the most promising locations for the survival of cometary ice. Additional numerical simulations are employed to show that solar wind ion deflection by strong lunar magnetic anomalies can produce local increases in the implantation rate of solar wind gases such as hydrogen. Author

N93-17252*# Rockwell International Science Center, Thousand Oaks, CA.
MAPPING THE MOON IN SOFT X RAYS: PROMISES AND CHALLENGES Abstract Only
R. M. Housley *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 32-33 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Recent ROSAT images reported by Schmitt et el. show that the sunlit part of the Moon is a significant source of very soft x rays. Stimulated by these observations, Edwards et al. have made an analysis of the response of the Moon to the solar soft x ray and EUV spectrum. They argue that much of the observed emission is in the form of discrete fluorescence lines in the energy range 25 to 100 eV, and that these lines are generally much stronger than the adjacent directly scattered solar background. On this basis they suggest that soft x ray fluorescence can be used to remotely obtain high-precision elemental maps of the lunar surface. Edwards et al. have continued to develop this idea and have suggested a system using soft x ray telescopes in lunar orbit, which could also obtain very good spatial resolution. This combination could be extremely valuable in furthering our understanding of lunar chemistry and potential resource distributions. High spatial resolution combined with the thin surface layer from which these soft x rays arise suggests the exciting possibility that x ray telescopes could map lunar volcanic volatiles from orbit. Author

N93-17253*# BDM International, Inc., Albuquerque, NM.
ASSESSMENT OF THE LUNAR SURFACE LAYER AND IN SITU MATERIALS TO SUSTAIN CONSTRUCTION-RELATED APPLICATIONS Abstract Only
Stewart W. Johnson and Koon Meng Chua *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 33-34 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Present and future technologies to facilitate lunar composition and resource assessment with applications to lunar surface construction are presented. We are particularly interested in the construction activity associated with lunar-based astronomy. We address, as an example, the use of ground-probing radar to help assess subsurface conditions at sites for observatories and other facilities. Author

N93-17254*# Los Alamos National Lab., NM.
AN IN SITU TECHNIQUE FOR ELEMENTAL ANALYSIS OF LUNAR SURFACES Abstract Only
K. Y. Kane and D. A. Cremers *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 34-35 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

An in situ analytical technique that can remotely determine the elemental constituents of solids has been demonstrated. Laser-Induced Breakdown

Spectroscopy (LIBS) is a form of atomic emission spectroscopy in which a powerful laser pulse is focused on a solid to generate a laser spark, or microplasma. Material in the plasma is vaporized, and the resulting atoms are excited to emit light. The light is spectrally resolved to identify the emitting species. LIBS is a simple technique that can be automated for inclusion aboard a remotely operated vehicle. Since only optical access to a sample is required, areas inaccessible to a rover can be analyzed remotely. A single laser spark both vaporizes and excites the sample so that near real-time analysis (a few minutes) is possible. This technique provides simultaneous multielement detection and has good sensitivity for many elements. LIBS also eliminates the need for sample retrieval and preparation preventing possible sample contamination. These qualities make the LIBS technique uniquely suited for use in the lunar environment. Author

N93-17255*# Los Alamos National Lab., NM.
ROBOTIC LUNAR ROVER TECHNOLOGIES AND SEI SUPPORTING TECHNOLOGIES AT SANDIA NATIONAL LABORATORIES Abstract Only
Paul R. Klarer *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 35 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Existing robotic rover technologies at Sandia National Laboratories (SNL) can be applied toward the realization of a robotic lunar rover mission in the near term. Recent activities at the SNL-RVR have demonstrated the utility of existing rover technologies for performing remote field geology tasks similar to those envisioned on a robotic lunar rover mission. Specific technologies demonstrated include low-data-rate teleoperation, multivehicle control, remote site and sample inspection, standard bandwidth stereo vision, and autonomous path following based on both internal dead reckoning and an external position location update system. These activities serve to support the use of robotic rovers for an early return to the lunar surface by demonstrating capabilities that are attainable with off-the-shelf technology and existing control techniques. The breadth of technical activities at SNL provides many supporting technology areas for robotic rover development. These range from core competency areas and microsensor fabrication facilities, to actual space qualification of flight components that are designed and fabricated in-house. Author

N93-17256*# North Dakota Univ., Grand Forks. Dept. of Space Studies.
LUNAR PROSPECTOR: A PRELIMINARY SURFACE REMOTE SENSING RESOURCE ASSESSMENT FOR THE MOON Abstract Only
A. A. Mardon *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 35-37 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

The potential existence of lunar volatiles is a scientific discovery that could distinctly change the direction of pathways of inner solar system human expansion. With a dedicated germanium gamma ray spectrometer launched in the early 1990's, surface water concentrations of 0.7 percent could be detected immediately upon full lunar polar orbit operations. The expense of lunar base construction and operation would be dramatically reduced over a scenario with no lunar volatile resources. Global surface mineral distribution could be mapped out and integrated into a GIS database for lunar base site selection. Extensive surface lunar mapping would also result in the utilization of archived Apollo images. A variety of remote sensing systems and their parameters have been proposed for use in the detection of these lunar ice masses. The detection or nondetection of subsurface and surface ice masses in lunar polar crater floors could dramatically direct the development pathways that the human race might follow in its radiation from the Earth to habitable locales in the inner terran solar system. Potential sources of lunar volatiles are described. The use of remote sensing to detect lunar volatiles is addressed. Author

N93-17257*# North Dakota Univ., Grand Forks. Dept. of Space Studies.
UTILIZATION OF GEOGRAPHIC INFORMATION SYSTEM IN LUNAR MAPPING Abstract Only
A. A. Mardon *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 37-39 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Substantial digital remote sensing, lunar orbital photography, Earth-based remote sensing, and mapping of a variety of surficial lunar phenomena have occurred since the advent of the Space Age. This has led to a bewildering and quite disparate collection of archival sources insofar as this digital data and its cartographic representation can be found within many countries of the world. The importance of this mapping program in support of human expansion onto our nearest planetary neighbor has been recognized. A series of small scale maps of the Moon at 1 km to 1 cm, done with the support of Geographic Information System (GIS), would serve decision makers well in the process of accessing the development of manned occupance of the Moon. Maps and the data that they are derived from are the primary way in which people explore new environments and use previously discovered data to increase the bounties of any exploration. The inherent advantage of GIS is that it would allow immediate online access on the Moon of topographically represented data with analysis either on site or from Earth. Author

N93-17258*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MOESSBAUER SPECTROSCOPY FOR LUNAR RESOURCE ASSESSMENT: MEASUREMENT OF MINERALOGY AND SOIL MATURITY Abstract Only
R. V. Morris, D. G. Agresti (Alabama Univ., Birmingham.), T. D. Shelfer (Alabama Univ., Birmingham.), M. M. Pimperl (Alabama Univ., Birmingham.), M.-H. Shen (Alabama Univ., Birmingham.), M. A. Gibson (Carbotek, Inc., Houston, TX.), and E. L. Wills *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 39-40 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

First-order assessment of lunar soil as a resource includes measurement of its mineralogy and maturity. Soils in which the mineral ilmenite is present in high concentrations are desirable feedstock for the production of oxygen at a lunar base. The maturity of lunar soils is a measure of their relative residence time in the upper 1 mm of the lunar surface. Increasing maturity implies increasing load of solar wind species (e.g., N, H, and He-3), decreasing mean grain size, and increasing glass content. All these physicochemical properties that vary in a regular way with maturity are important parameters for assessing lunar soil as a resource. For example, He-3 can be extracted and potentially used for nuclear fusion. A commonly used index for lunar soil maturity is I(sub s)/FeO, which is the concentration of fine-grained metal determined by ferromagnetic resonance (I(sub s)) normalized to the total iron content (as FeO). I(sub s)/FeO has been measured for virtually every soil returned by the Apollo and Luna missions to the Moon. Because the technique is sensitive to both oxidation state and mineralogy, iron Moessbauer spectroscopy (FeMS) is a viable technique for in situ lunar resource assessment. Its utility for mineralogy is apparent from examination of published FeMS data for lunar samples. From the data published, it can be inferred that FeMS data can also be used to determine soil maturity. The use of FeMS to determine mineralogy and maturity and progress on development of a FeMS instrument for lunar surface use are discussed. Author

N93-17259*# Los Alamos National Lab., NM.
GAMMA RAY AND NEUTRON SPECTROMETER FOR THE LUNAR RESOURCE MAPPER Abstract Only
C. E. Moss, R. C. Byrd, D. M. Drake, W. C. Feldman, R. A. Martin, M. A. Merrigan, and R. C. Reedy *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 40-41 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

One of the early Space Exploration Initiatives will be a lunar orbiter to map the elemental composition of the Moon. This mission will support further lunar exploration and habitation and will provide a valuable dataset for understanding lunar geological processes. The proposed payload will consist of the gamma ray and neutron spectrometers which are discussed, an x ray fluorescence imager, and possibly one or two other instruments. Author

N93-17260*# Exportech Co., Inc., New Kensington, PA.
MAGNETIC SUSCEPTIBILITY MEASUREMENTS FOR IN SITU CHARACTERIZATION OF LUNAR SOIL Abstract Only
R. R. Oder *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 41-42 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Magnetic separation is a viable method for concentration of components of lunar soils and rocks for use as feedstocks for manufacture of metals, oxygen, and for recovery of volatiles such as He-3. Work with lunar materials indicates that immature soils are the best candidates for magnetic beneficiation. The magnetic susceptibility at which selected soil components such as anorthite, ilmenite, or metallic iron are separated is not affected by soil maturity, but the recovery of the concentrated components is. Increasing soil maturity lowers recovery. Mature soils contain significant amounts of glass-encased metallic iron. Magnetic susceptibility, which is sensitive to metallic iron content, can be used to measure soil maturity. The relationship between the ratio of magnetic susceptibility and iron oxide and the conventional maturity parameter, I(sub s)/FeO, ferromagnetic resonant intensity divided by iron oxide content is given. The magnetic susceptibilities were determined using apparatus designed for magnetic separation of the lunar soils. Author

N93-17261*# Brown Univ., Providence, RI.
THE QUICKEST, LOWEST-COST LUNAR RESOURCE ASSESSMENT PROGRAM: INTEGRATED HIGH-TECH EARTH-BASED ASTRONOMY Abstract Only
Carle M. Pieters *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 42-44 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Science and technology applications for the Moon have not fully kept pace with technical advancements in sensor development and analytical information extraction capabilities. Appropriate unanswered questions for the Moon abound, but until recently there has been little motivation to link sophisticated technical capabilities with specific measurement and analysis projects. Over the last decade enormous technical progress has been made in the development of (1) CCD photometric array detectors; (2) visible to near-infrared imaging spectrometers; (3)infrared spectroscopy; (4) high-resolution dual-polarization radar imaging at 3.5, 12, and 70 cm; and equally important (5) data analysis and information extraction techniques using compact powerful computers. Parts of each of these have been tested separately, but there has been no programmatic effort to develop and optimize instruments to meet lunar science and resource assessment needs (e.g., specific wavelength range, resolution, etc.) nor to coordinate activities so that the symbiotic relation between different kinds of data can be fully realized. No single type of remotely acquired data completely characterizes the lunar environment, but there has been little opportunity for integration of diverse advanced sensor data for the Moon. Two examples of technology concepts for lunar measurements are given. Using VIS/near-IR spectroscopy, the mineral composition of surface material can be derived from visible and near-infrared radiation reflected from the surface. The surface and subsurface scattering properties of the Moon can be analyzed using radar backscattering imaging. Author

N93-17262*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LUNAR SURFACE ROVERS Abstract Only
J. B. Plescia, A. L. Lane, and D. Miller *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 44-45 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Many questions of lunar science remain unanswered because of a lack of specific data. With the potential for returning humans to the Moon and establishing a long-term presence there, a new realm of exploration is possible. Numerous plans have been outlined for orbital and surface missions. The capabilities and objectives of a small class of rovers to be deployed on the lunar surface are described. The objective of these small rovers is to collect detailed in situ information about the composition and distribution of materials on the lunar surface. Those data, in turn, would be applied to a variety of lunar geoscience questions and form a basis for planning human activities on the lunar surface. Author

N93-17263*# Los Alamos National Lab., NM.
COMBINED GAMMA RAY/NEUTRON SPECTROSCOPY FOR MAPPING LUNAR RESOURCES Abstract Only
R. C. Reedy, R. C. Byrd, D. M. Drake, W. C. Feldman, J. Masarik, and C. E. Moss *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 45-46 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Some elements in the Moon can be resources, such as hydrogen and oxygen. Other elements, like Ti or the minerals in which they occur, such as ilmenite, could be used in processing lunar materials. Certain elements can also be used as tracers for other elements or lunar processes, such as hydrogen for mature regoliths with other solar-wind-implanted elements like helium, carbon, and nitrogen. A complete knowledge of the elemental composition of a lunar region is desirable both in identifying lunar resources and in lunar geochemical studies, which also helps in identifying and using lunar resources. The use of gamma ray and neutron spectroscopy together to determine abundances of many elements in the top few tens of centimeters of the lunar surface is discussed. To date, very few discussions of elemental mapping of planetary surfaces considered measurements of both gamma rays and the full range of neutron energies. The theories for gamma ray and neutron spectroscopy of the Moon and calculations of leakage fluxes are presented here with emphasis on why combined gamma ray/neutron spectroscopy is much more powerful than measuring either radiation alone. Author

N93-17264*# Washington Univ., Saint Louis, MO.
COMPAS: COMPOSITIONAL MINERALOGY WITH A PHOTOACOUSTIC SPECTROMETER Abstract Only
W. Hayden Smith *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 46-47 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

There is an important need for an in situ method of mineral and rock identification and quantification that provides true absorption spectra for a wide spectral range for lunar lander/rover missions. Many common minerals such as feldspars, magnetite, ilmenite, and amorphous fine solids or glasses, can exhibit flat spectral reflectances in the 400-2500 nm spectral region that render inaccurate or difficult their spectral detection and quantitative analysis. Ideal rock and mineral spectra are, of course, pure absorption spectra that are independent of the spectral effects of scattering, particle size, and distribution that can result in a suppression or distortion of their spectral features. This ideal seldom pertains to real samples. Since sample preparation is difficult and may fundamentally alter the observed diffuse spectral reflectance, an in situ spectral measurement method for rocks and minerals on the Moon, insensitive to the sample morphology, would be invaluable. Photoacoustic spectroscopy is a well-established technique appropriate for this task that has been widely applied in condensed-phase spectral studies of complex, highly light scattering, unprepared samples of everything from coal to whole blood, including rock and mineral characterization. A Compositional Mineralogy Photoacoustic Spectrometer, or COMPAS, can enable in situ spectral measurement of rocks and minerals, bypassing the major limitations of diffuse reflectance spectroscopy. COMPAS spectral capabilities for rock and mineral samples will be incorporated into an instrument prototype specifically for lunar measurements, compatible with rover capabilities. Author

N93-17265*# Washington Univ., Saint Louis, MO.
LUNAR UV-VISIBLE-IR MAPPING INTERFEROMETRIC SPECTROMETER Abstract Only
W. Hayden Smith, L. Haskin, R. Korotev, R. Arvidson, W. McKinnon, B. Hapke (Pittsburgh Univ., PA.), S. Larson (Arizona Univ., Tucson.), and P. Lucey (Hawaii Univ., Honolulu.) *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 47 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Ultraviolet-visible-infrared mapping digital array scanned interferometers for lunar compositional surveys was developed. The research has defined a no-moving-parts, low-weight and low-power, high-throughput, and electronically adaptable digital array scanned interferometer that achieves measurement objectives encompassing and improving upon all the requirements defined by the LEXSWIG for lunar mineralogical investigation.

In addition, LUMIS provides a new, important, ultraviolet spectral mapping, high-spatial-resolution line scan camera, and multispectral camera capabilities. An instrument configuration optimized for spectral mapping and imaging of the lunar surface and provide spectral results in support of the instrument design are described. Author

N93-17266*# Lunar and Planetary Inst., Houston, TX.
LUNAR RESOURCE ASSESSMENT: STRATEGIES FOR SURFACE EXPLORATION Abstract Only
Paul D. Spudis *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 47-48 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Use of the indigenous resources of space to support long-term human presence is an essential element of the settlement of other planetary bodies. We are in a very early stage of understanding exactly how and under what circumstances space resources will become important. The materials and processes to recover them that we now think are critical may not ultimately be the raison d'etre for a resource utilization program. However, the need for strategic thinking proceeds in parallel with efforts to implement such plans and it is not too soon to begin thinking how we could and should use the abundant resources of materials and energy available from the Moon. The following commodities from the Moon are discussed: (1) bulk regolith, for shielding and construction on the lunar surface (ultimately for export to human-tended stations in Earth-Moon space), and (2) oxygen and hydrogen, for propellant and life support. Author

N93-17267*# Cornell Univ., Ithaca, NY.
HIGH-RESOLUTION EARTH-BASED LUNAR RADAR STUDIES: APPLICATIONS TO LUNAR RESOURCE ASSESSMENT Abstract Only
N. J. S. Stacy and D. B. Campbell *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 48-49 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

The lunar regolith will most likely be a primary raw material for lunar base construction and resource extraction. High-resolution radar observations of the Moon provide maps of radar backscatter that have intensity variations generally controlled by the local slope, material, and structural properties of the regolith. The properties that can be measured by the radar system include the dielectric constant, density, loss tangent, and wavelength scale roughness. The radar systems currently in operation at several astronomical observatories provide the ability to image the lunar surface at spatial resolutions approaching 30 m at 3.8 cm and 12.6 cm wavelengths and approximately 500 m at 70 cm wavelength. The radar signal penetrates the lunar regolith to a depth of 10-20 wavelengths so the measured backscatter contains contributions from the vacuum-regolith interface and from wavelength-scale heterogeneities in the electrical properties of the subsurface material. The three wavelengths, which are sensitive to different scale structures and scattering volumes, provide complementary information on the regolith properties. Aims of the previous and future observations include (1) analysis of the scattering properties associated with fresh impact craters, impact crater rays, and mantled deposits; (2) analysis of high-incidence-angle observations of the lunar mare to investigate measurement of the regolith dielectric constant and hence porosity; (3) investigation of interferometric techniques using two time-delayed observations of the same site, observations that require a difference in viewing geometry less than 0.05 deg and, hence, fortuitous alignment of the Earth-Moon system when visible from Arecibo Observatory. Author

N93-17268*# Hawaii Univ., Honolulu.
REMOTE ASSESSMENT OF LUNAR RESOURCE POTENTIAL Abstract Only
G. Jeffrey Taylor *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 49-50 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Assessing the resource potential of the lunar surface requires a well-planned program to determine the chemical and mineralogical composition of the Moon's surface at a range of scales. The exploration program must include remote sensing measurements (from both Earth's surface and lunar orbit), robotic in situ analysis of specific places, and eventually, human field work by trained geologists. Remote sensing data is discussed. Resource assessment requires some idea of what resources will be needed. Studies thus far have concentrated on oxygen and hydrogen production for propellant and life support, He-3 for export as fuel for nuclear fusion reactors, and use of bulk regolith for shielding and construction materials. The measurement requirements for assessing these resources are given and discussed briefly. Author

N93-17269*# Los Alamos National Lab., NM.
A COMBINED XRD/XRF INSTRUMENT FOR LUNAR RESOURCE ASSESSMENT Abstract Only
D. T. Vaniman, D. L. Bish, S. J. Chipera, and J. D. Blacic *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 50-51 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Robotic surface missions to the Moon should be capable of measuring mineral as well as chemical abundances in regolith samples. Although much is already known about the lunar regolith, our data are far from comprehensive. Most of the regolith samples returned to Earth for analysis had lost the upper surface, or it was intermixed with deeper regolith. This upper surface is the part of the regolith most recently exposed to the solar wind; as such it will be important to resource assessment. In addition, it may be far easier to mine and process the uppermost few centimeters of regolith over a broad area than to engage in deep excavation of a smaller area. The most direct means of analyzing the regolith surface will be by studies in situ. In addition, the analysis of the impact-origin regolith surfaces, the Fe-rich glasses of mare pyroclastic deposits, are of resource interest, but are inadequately known; none of the extensive surface-exposed pyroclastic deposits of the Moon have been systematically sampled, although we know something about such deposits from the Apollo 17 site. Because of the potential importance of pyroclastic deposits, methods to quantify glass as well as mineral abundances will be important to resource evaluation. Combined x ray diffraction (XRD) and x ray fluorescence (XRF) analysis will address many resource characterization problems on the Moon. XRF methods are valuable for obtaining full major-element abundances with high precision. Such data, collected in parallel with quantitative mineralogy, permit unambiguous determination of both mineral and chemical abundances where concentrations are high enough to be of resource grade. Collection of both XRD and XRF data from a single sample provides simultaneous chemical and mineralogic information. These data can be used to correlate quantitative chemistry and mineralogy as a set of simultaneous linear equations, the solution of which can lead to full characterization of the sample. The use of Rietveld methods for XRD data analysis can provide a powerful tool for quantitative mineralogy and for obtaining crystallographic data on complex minerals. Author

N93-17270*# Oregon L-5 Society, Oregon City.
LUNAR LAVA TUBE SENSING Abstract Only
Cheryl Lynn York, Bryce Walden, Thomas L. Billings, and P. Douglas Reeder *In* Lunar and Planetary Inst., Joint Workshop on New Technologies for Lunar Resource Assessment 1992 p 51-52 (For primary document see N93-17233 05-91)
Avail: CASI HC A01/MF A01

Large (greater than 300 m diameter) lava tube caverns appear to exist on the Moon and could provide substantial safety and cost benefits for lunar bases. Over 40 m of basalt and regolith constitute the lava tube roof and would protect both construction and operations. Constant temperatures of -20 C reduce thermal stress on structures and machines. Base designs need not incorporate heavy shielding, so lightweight materials can be used and construction can be expedited. Identification and characterization of lava tube caverns can be incorporated into current precursor lunar mission plans. Some searches can even be done from Earth. Specific recommendations for lunar lava tube search and exploration are (1) an Earth-based radar interferometer, (2) an Earth-penetrating radar (EPR) orbiter, (3) kinetic penetrators for lunar lava tube confirmation, (4) a 'Moon Bat' hovering rocket vehicle, and (5) the use of other proposed landers and orbiters to help find lunar lava tubes. Author

N93-17414*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE SECOND CONFERENCE ON LUNAR BASES AND SPACE ACTIVITIES OF THE 21ST CENTURY, VOLUME 1

Wendell W. Mendell, ed., John W. Alred, ed. (Eagle Engineering, Inc., Houston, TX.), Larry S. Bell, ed. (Houston Univ., TX.), Mark J. Cintala, ed., Thomas M. Crabb, ed. (Orbital Technologies Corp., Madison, WI.), Robert H. Durrett, ed. (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.), Ben R. Finney, ed. (Hawaii Univ., Honolulu.), H. Andrew Franklin, ed. (Bechtel National, Inc., San Francisco, CA.), James R. French, ed. (JRF Engineering Services, La Canada, CA.), and Joel S. Greenberg, ed. (Princeton Synergetics, Inc., NJ.) et al Washington Sep. 1992 365 p Conference held in Houston, TX, 5-7 Apr. 1988

(NASA-CP-3166-Vol-1; S-684-Vol-1; NAS 1.55:3166-Vol-1) Avail: CASI HC A16/MF A03

These papers comprise a peer-review selection of presentations by authors from NASA, LPI industry, and academia at the Second Conference (April 1988) on Lunar Bases and Space Activities of the 21st Century, sponsored by the NASA Office of Exploration and the Lunar Planetary Institute. These papers go into more technical depth than did those published from the first NASA-sponsored symposium on the topic, held in 1984. Session topics covered by this volume include (1) design and operation of transportation systems to, in orbit around, and on the Moon, (2) lunar base site selection, (3) design, architecture, construction, and operation of lunar bases and human habitats, and (4) lunar-based scientific research and experimentation in astronomy, exobiology, and lunar geology. For individual titles, see N93-17415 through N93-17458.

N93-17415*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CONCEPTUAL ANALYSIS OF A LUNAR BASE TRANSPORTATION SYSTEM

Trevor D. Hoy (Joint Inst. for Advancement of Flight Sciences, Hampton, VA.), Lloyd B. Johnson, III (Joint Inst. for Advancement of Flight Sciences, Hampton, VA.), Mark B. Persons (Joint Inst. for Advancement of Flight Sciences, Hampton, VA.), and Robert L. Wright *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 3-15 Previously announced in IAA as A88-38687 (For primary document see N93-17414 05-91)

Avail: CASI HC A03/MF A03

Important to the planning for a lunar base is the development of transportation requirements for the establishment and maintenance of that base. This was accomplished as part of a lunar base systems assessment study conducted by the NASA Langley Research Center in conjunction with the NASA Johnson Space Center. Lunar base parameters are presented using a baseline lunar facility concept and timeline of developmental phases. Masses for habitation and scientific modules, power systems, life support systems, and thermal control systems were generated, assuming space station technology as a starting point. The masses were manifested by grouping various systems into cargo missions and interspersing manned flights consistent with construction and base maintenance timelines. A computer program that sizes the orbital transfer vehicles (OTV's), lunar landers, lunar ascenders, and the manned capsules was developed. This program consists of an interative technique to solve the rocket equation successively for each velocity correction (delta V) in a mission. The delta V values reflect integrated trajectory values and include gravity losses. As the program computed fuel masses, it matched structural masses from General Dynamics' modular space-based OTV design. Variables in the study included the operation mode (i.e., expendable vs. reusable and single-stage vs. two-stage OTV's), cryogenic specific impulse, reflecting different levels of engine technology, and aerobraking vs. all-propulsive return to Earth orbit. The use of lunar-derived oxygen was also examined for its general impact. For each combination of factors, the low-Earth orbit (LEO) stack masses and Earth-to-orbit (ETO) lift requirements are summarized by individual mission and totaled for the developmental phase. In addition to these discrete data, trends in the variation of study parameters are presented. Author

N93-17416*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LUNAR BASE MISSION TECHNOLOGY ISSUES AND ORBITAL DEMONSTRATION REQUIREMENTS ON SPACE STATION

Charles P. Llewellyn (Analytical Mechanics Associates, Inc., Hampton, VA.) and Deene J. Weidman *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 17-23 (For primary document see N93-17414 05-91)

Avail: CASI HC A02/MF A03

The International Space Station has been the object of considerable design, redesign, and alteration since it was originally proposed in early 1984. In the intervening years the station has slowly evolved to a specific design that was thoroughly reviewed by a large agency-wide Critical Evaluation Task Force (CETF). As space station designs continue to evolve, studies must be conducted to determine the suitability of the current design for some of the primary purposes for which the station will be used. This paper concentrates on the technology requirements and issues, the on-orbit demonstration and verification program, and the space station focused support required prior to the establishment of a permanently manned lunar base as identified in the National Commission on Space report. Technology issues associated with the on-orbit assembly and processing of the lunar vehicle flight elements are also discussed. Author

N93-17417*# McDonnell-Douglas Astronautics Co., Huntington Beach, CA. Space Station Div.

ADAPTION OF SPACE STATION TECHNOLOGY FOR LUNAR OPERATIONS

J. M. Garvey *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 25-29 (For primary document see N93-17414 05-91)

Avail: CASI HC A01/MF A03

Space Station Freedom technology will have the potential for numerous applications in an early lunar base program. The benefits of utilizing station technology in such a fashion include reduced development and facility costs for lunar base systems, shorter schedules, and verification of such technology through space station experience. This paper presents an assessment of opportunities for using station technology in a lunar base program, particularly in the lander/ascent vehicles and surface modules. Author

N93-17418*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

OPERATIONAL CONSIDERATIONS FOR LUNAR TRANSPORTATION

Andrew J. Petro *In its* The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 31-34 (For primary document see N93-17414 05-91)

Avail: CASI HC A01/MF A03

Transportation of people and cargo between low Earth orbit and the surface of the Moon will be one of the most important elements in a lunar base program. This paper identifies some of the important lessons from the space shuttle program and discusses their application in future lunar vehicle operations. Also, some unique challenges in flight planning, training, vehicle servicing, payload integration, and flight control for lunar transportation are outlined. This paper relies heavily on recent studies of space shuttle development and operations with the goal of applying shuttle experience in the design of a practical and efficient lunar transportation system. Author

N93-17419*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ELECTRIC PROPULSION FOR LUNAR EXPLORATION AND LUNAR BASE DEVELOPMENT

Bryan Palaszewski (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 35-45 (For primary document see N93-17414 05-91)

Avail: CASI HC A03/MF A03

Using electric propulsion to deliver materials to lunar orbit for the development and construction of a lunar base was investigated. Because the mass of the base and its life-cycle resupply mass are large, high specific impulse propulsion systems may significantly reduce the transportation system mass and cost. Three electric propulsion technologies (arcjet, ion, and magnetoplasmadynamic (MPD) propulsion) were compared with oxygen/hydrogen propulsion for a lunar base development scenario. Detailed estimates of the orbital transfer vehicles' (OTV's) masses and their propellant masses are presented. The fleet sizes for the chemical and electric propulsion systems are estimated. Ion and MPD propulsion systems enable significant launch mass savings over O2/H2 propulsion.

Because of the longer trip time required for the low-thrust OTV's, more of them are required to perform the mission model. By offloading the lunar cargo from the manned O2/H2 OTV missions onto the electric propulsion OTV's, a significant reduction of the low Earth orbit (LEO) launch mass is possible over the 19-year base development period. Author

N93-17420*# California Univ., San Diego, La Jolla. Space Inst.
ADVANCED PROPULSION FOR LEO-MOON TRANSPORT. 1: A METHOD FOR EVALUATING ADVANCED PROPULSION PERFORMANCE
Martin O. Stern *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 47-54 (For primary document see N93-17414 05-91)
(Grant NAG9-186)
Avail: CASI HC A02/MF A03

This report describes a study to evaluate the benefits of advanced propulsion technologies for transporting materials between low Earth orbit and the Moon. A relatively conventional reference transportation system, and several other systems, each of which includes one advanced technology component, are compared in terms of how well they perform a chosen mission objective. The evaluation method is based on a pairwise life-cycle cost comparison of each of the advanced systems with the reference system. Somewhat novel and economically important features of the procedure are the inclusion not only of mass payback ratios based on Earth launch costs, but also of repair and capital acquisition costs, and of adjustments in the latter to reflect the technological maturity of the advanced technologies. The required input information is developed by panels of experts. The overall scope and approach of the study are presented in the introduction. The bulk of the paper describes the evaluation method; the reference system and an advanced transportation system, including a spinning tether in an eccentric Earth orbit, are used to illustrate it. Author

N93-17421*# California Univ., San Diego, La Jolla. Space Inst.
ADVANCED PROPULSION FOR LEO-MOON TRANSPORT. 2: TETHER CONFIGURATIONS IN THE LEO-MOON SYSTEM
J. R. Arnold and W. B. Thompson *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 55-59 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

This brief work discusses a possible application of a tether as a dynamical element in a low Earth orbit (LEO)-Moon transport system, and is a part of the Cal Space study of that transport system. To be specific, that study concentrated on the downward transport of O2 from the Moon to LEO, where it is stored for use as a rocket propellant, thus reducing Earth liftoff mass requirements by a factor of about 8. Moreover, in order to display clearly the role of advanced technology, only one novel technology was introduced at a single node in the transport system, the rest being 'conventional' rocket transport. Tethers were found useful in several different roles: hanging from platforms in lunar orbits, as supports for elevators, spinning in LEO, or spinning in a tether transport orbit, an elliptical orbit with perigee at approximately 600 km. This last use is considered here. Presented are the usefulness of the tether, nature of the tether system, the apparatus needed to support, deploy, and control it, and a discussion of needed developments. Author

N93-17422*# General Dynamics Corp., San Diego, CA. Space Systems Div.
ADVANCED PROPULSION FOR LEO-MOON TRANSPORT. 3: TRANSPORTATION MODEL M.S. Thesis - California Univ.
Mark W. Henley *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 61-68 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

A simplified computational model of low Earth orbit-Moon transportation system has been developed to provide insight into the benefits of new transportation technologies. A reference transportation infrastructure, based upon near-term technology developments, is used as a departure point for assessing other, more advanced alternatives. Comparison of the benefits of technology application, measured in terms of a mass payback ratio, suggests that several of the advanced technology alternatives could substantially improve the efficiency of low Earth orbit-Moon transportation. Author

N93-17423*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ENABLING LUNAR AND SPACE MISSIONS BY LASER POWER TRANSMISSION
R. J. DeYoung, J. E. Nealy, D. H. Humes, and W. E. Meador *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 69-73 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

Applications are proposed for laser power transmission on the Moon. A solar-pumped laser in lunar orbit would beam power to the lunar surface for conversion into either electricity or propulsion needs. For example, lunar rovers could be much more flexible and lighter than rovers using other primary power sources. Also, laser power could be absorbed by lunar soil to create a hard glassy surface for dust-free roadways and launch pads. Laser power could also be used to power small lunar rockets or orbital transfer vehicles, and finally, photovoltaic laser converters could power remote excavation vehicles and human habitats. Laser power transmission is shown to be a highly flexible, enabling primary power source for lunar missions. Author

N93-17424*# Wisconsin Univ., Madison. Fusion Technology Inst.
LUNAR He-3, FUSION PROPULSION, AND SPACE DEVELOPMENT
John F. Santarius *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 75-81 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

The recent identification of a substantial lunar resource of the fusion energy fuel He-3 may provide the first terrestrial market for a lunar commodity and, therefore, a major impetus to lunar development. The impact of this resource-when burned in D-He-3 fusion reactors for space power and propulsion-may be even more significant as an enabling technology for safe, efficient exploration and development of space. One possible reactor configuration among several options, the tandem mirror, illustrates the potential advantages of fusion propulsion. The most important advantage is the ability to provide either fast, piloted vessels or high-payload-fraction cargo vessels due to a range of specific impulses from 50 sec to 1,000,000 sec at thrust-to-weight ratios from 0.1 to 5x10(exp -5). Fusion power research has made steady, impressive progress. It is plausible, and even probable, that fusion rockets similar to the designs presented here will be available in the early part of the twenty-first century, enabling a major expansion of human presence into the solar system. Author

N93-17425*# PRC Systems Services Co., Hampton, VA. Aerospace Div.
THE TRANSPORTATION DEPOT: AN ORBITING VEHICLE SUPPORT FACILITY
Martin J. Kaszubowski and J. Kirk Ayers *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 83-93 (For primary document see N93-17414 05-91)
(Contract NAS1-18000)
Avail: CASI HC A03/MF A03

This paper describes the details of an effort to produce conceptual designs for an orbiting platform, called a transportation depot, to handle assembly and processing of lunar, Martian, and related vehicles. High-level requirements for such a facility were established, and several concepts were developed to meet those requirements. By showing that the critical rigid-body momentum characteristics of each concept are similar to those of the dual-keel space station, some insight was gained about the controllability and utility of this type of facility. Finally, several general observations were made that highlight the advantages and disadvantages of particular design features. Author

N93-17426*# Webb, Murray and Associates, Inc., Houston, TX.
DEVELOPING A SAFE ON-ORBIT CRYOGENIC DEPOT
Nicholas J. Bahr *In* NASA. Johnson Space Center, The Second Conference

on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 95-100 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

New U.S. space initiatives will require technology to realize planned programs such as piloted lunar and Mars missions. Key to the optimal execution of such missions are high performance orbit transfer vehicles and propellant storage facilities. Large amounts of liquid hydrogen and oxygen demand a uniquely designed on-orbit cryogenic propellant depot. Because of the inherent dangers in propellant storage and handling, a comprehensive system safety program must be established. This paper shows how the myriad and complex hazards demonstrate the need for an integrated safety effort to be applied from program conception through operational use. Even though the cryogenic depot is still in the conceptual stage, many of the hazards have been identified, including fatigue due to heavy thermal loading from environmental and operating temperature extremes, micrometeoroid and/or depot ancillary equipment impact (this is an important problem due to the large surface area needed to house the large quantities of propellant), docking and maintenance hazards, and hazards associated with extended extravehicular activity. Various safety analysis techniques were presented for each program phase. Specific system safety implementation steps were also listed. Enhanced risk assessment was demonstrated through the incorporation of these methods. Author

N93-17427*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LUNAR LANDER STAGE REQUIREMENTS BASED ON THE CIVIL NEEDS DATA BASE
John A. Mulqueen *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 101-117 (For primary document see N93-17414 05-91)
Avail: CASI HC A03/MF A03

This paper examines the lunar lander stages that will be necessary for the future exploration and development of the Moon. Lunar lander stage sizing is discussed based on the projected lunar payloads listed in the Civil Needs Data Base. Factors that will influence the lander stage design are identified and discussed. Some of these factors are (1) lunar orbiting and lunar surface lander bases; (2) implications of direct landing trajectories and landing from a parking orbit; (3) implications of landing site and parking orbit; (4) implications of landing site and parking orbit selection; (5) the use of expendable and reusable lander stages; and (6) the descent/ascent trajectories. Data relating the lunar lander stage design requirements to each of the above factors and others are presented in parametric form. These data will provide useful design data that will be applicable to future mission model modifications and design studies. Author

N93-17428*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LUNAR LANDER CONCEPTUAL DESIGN
J. M. Stecklein, A. J. Petro, W. R. Stump (Eagle Engineering, Inc., Houston, TX.), A. S. Adorjan (Eagle Engineering, Inc., Houston, TX.), T. V. Chambers (Eagle Engineering, Inc., Houston, TX.), M. DOnofrio (Eagle Engineering, Inc., Houston, TX.), J. K. Hirasaki (Eagle Engineering, Inc., Houston, TX.), O. G. Morris (Eagle Engineering, Inc., Houston, TX.), G. Nudd (Eagle Engineering, Inc., Houston, TX.), and R. P. Rawlings (Eagle Engineering, Inc., Houston, TX.) et al *In its* The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 119-131 (For primary document see N93-17414 05-91)
Avail: CASI HC A03/MF A03

This paper is a first look at the problems of building a lunar lander to support a small lunar surface base. A series of trade studies was performed to define the lander. The initial trades concerned choosing number of stages, payload mass, parking orbit altitude, and propellant type. Other important trades and issues included plane change capability, propellant loading and maintenance location, and reusability considerations. Given a rough baseline, the systems were then reviewed. A conceptual design was then produced. The process was carried through only one iteration. Many more iterations are needed. A transportation system using reusable, aerobraked orbital transfer vehicles (OTV's) is assumed. These OTV's are assumed to be based and maintained at a low Earth orbit (LEO) space station, optimized for transportation functions. Single- and two-stage OTV stacks are considered. The OTV's make the translunar injection (TLI), lunar orbit insertion (LOI), and trans-Earth injection (TEI) burns, as well as midcourse and perigee raise maneuvers. Author

N93-17429*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
PRELIMINARY DEFINITION OF A LUNAR LANDING AND LAUNCH FACILITY (COMPLEX 39L)
H. Dennis Matthews, Eric B. Jenson (Florida Inst. of Tech., Melbourne.), and Jerald N. Linsley (Florida Inst. of Tech., Melbourne.) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 133-138 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

A preliminary definition of a lunar landing and launch facility has been formulated. A permanently manned lunar base and a baseline lunar module are assumed. The major features of the facility are specified and major design areas are described. Author

N93-17430*# Eagle Engineering, Inc., Houston, TX.
LUNAR BASE LAUNCH AND LANDING FACILITIES CONCEPTUAL DESIGN
Paul G. Phillips, Charles H. Simonds, and William R. Stump *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 139-151 (For primary document see N93-17414 05-91)
Avail: CASI HC A03/MF A03

The purpose of this study was to perform a first look at the requirements for launch and landing facilities for early lunar bases and to prepared conceptual designs for some of these facilities. The emphasis of the study is on the facilities needed from the first manned landing until permanent occupancy, the Phase 2 lunar base. Factors including surface characteristics, navigation system, engine blast effects, and expected surface operations are used to develop landing pad designs, and definitions fo various other elements of the launch and landing facilities. Finally, the dependence of the use of these elements and the evolution of the facilities are established. Author

N93-17431*# Moscow State Univ. (USSR). Astronomical Inst.
THE CHOICE OF THE LOCATION OF THE LUNAR BASE
V. V. Schevchenko *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 155-161 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

The development of modern methods of remote sensing of the lunar surface and data from lunar studies by space vehicles make it possible to assess scientifically the expediency of the location of the lunar base in a definite region on the Moon. The preliminary choice of the site is important for tackling a range of problems associated with ensuring the activity of a manned lunar base and with fulfilling the research program. Based on astronomical data, we suggest the Moon's western hemisphere, specifically the western part of Oceanus Procellarum, where natural, scientifically interesting objects have been identified, as have surface rocks with enhanced contents of ilmenite, a possible source of oxygen. A comprehensive evaluation of the region shows that, as far as natural features are concerned, it is a key one for solving the main problems of the Moon's origin and evolution. Author

N93-17432*# Geological Survey, Flagstaff, AZ. Branch of Astrogeology.
GEOLOGICAL AND GEOPHYSICAL FIELD INVESTIGATIONS FROM A LUNAR BASE AT MARE SMYTHII
Paul D. Spudis and Lon L. Hood (Arizona Univ., Tucson.) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 163-174 (For primary document see N93-17414 05-91)
Avail: CASI HC A03/MF A03

Mare Smythii, located on the equator and east limb of the Moon, has a great variety of scientific and economic uses as the site for a permanent lunar base. Here a complex could be established that would combine the advantages of a nearside base (for ease of communications with Earth and normal operations) with those of a farside base (for shielding a radio

astronomical observatory from the electromagnetic noise of Earth). The Mare Smythii region displays virtually the entire known range of geological processes and materials found on the Moon; from this site, a series of field traverses and investigations could be conducted that would provide data on and answers to fundamental questions in lunar geoscience. This endowment of geological materials also makes the Smythii region attractive for the mining of resources for use both on the Moon and in Earth-Moon space. We suggest that the main base complex be located at 0, 90 deg E, within the mare basalts of the Smythii basin; two additional outposts would be required, one at 0, 81 deg E to maintain constant communications with Earth, and and the other, at 0, 101 deg E on the lunar farside, to serve as a radio astronomical observatory. The bulk of lunar surface activities could be conducted by robotic teleoperations under the direct control of the human inhabitants of the base. Author

N93-17433*# World Space Foundation, Pasadena, CA.
A LUNAR POLAR EXPEDITION
Richard Dowling, Robert L. Staehle, and Tomas Svitek *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 175-182 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

Advanced exploration and development in harsh environments require mastery of basic human survival skill. Expeditions into the lethal climates of Earth's polar regions offer useful lessons for tommorrow's lunar pioneers. In Arctic and Antarctic exploration, 'wintering over' was a crucial milestone. The ability to establish a supply base and survive months of polar cold and darkness made extensive travel and exploration possible. Because of the possibility of near-constant solar illumination, the lunar polar regions, unlike Earth's may offer the most hospitable site for habitation. The World Space Foundation is examining a scenario for establishing a five-person expeditionary team on the lunar north pole for one year. This paper is a status report on a point design addressing site selection, transportation, power, and life support requirements. Author

N93-17434*# Hawaii Univ., Honolulu. Planetary Geoscience Div.
ASTRONOMY ON THE MOON: GEOLOGICAL CONSIDERATIONS c89
G. Jeffrey Taylor *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 183-187 (For primary document see N93-17414 05-91)
(SOEST-Contrib-2399; PGD-Contrib-630) Avail: CASI HC A01/MF A03

The Moon is an excellent site for astronomical observations. This paper describes two geological aspects related to astronomy from the Moon. First it evaluates the sources of gases near a lunar base as input to calculations reported in a separate paper on the growth of an artificial lunar atmosphere. The results suggest that mining for He-3 could produce the most gas (1 kg/sec), but rocket exhaust (0.1 kg/sec) and habitat venting (0.5 kg/sec) are also important. Second, the paper discusses criteria that need to be considered when determining the site of a lunar astronomical facility. These are longitude and latitude (equatorial sites are favored), topography (important to be relatively flat for ease of installation), distance from a lunar base (to be free of seismic noise, dust, and gases), the site's value to lunar geoscience (other factors being equal, a geologically diverse site is better), and its value as a materials resource (mining and observatories are incompatible). Author

N93-17435*# Wisconsin Univ., Madison. Center for Space Automation and Robotics.
HELIUM MINING ON THE MOON: SITE SELECTION AND EVALUATION
Eugene N. Cameron *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 189-197 Previously announced as N89-14850 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

The feasibility of recovering helium (He) from the Moon as a source of fusion energy on Earth is currently being studied at the University of Wisconsin. Part of this study is selection and evaluation of potential sites for lunar He mining. Selection and evaluation of potential mining sites are based on four salient findings by various investigators of lunar samples: (1) Regoliths from areas underlain by highland materials contain less than 20 wppm He; (2) Certain maria regoliths contain less than 20 wppm He, but other contain 25 to 49 wppm; (3) The He content of a mare regolith is a function of its composition; regoliths rich in Ti are relatively rich in He; and (4) He is concentrated in the less than 100-micron size fractions of regoliths. The first three findings suggest that maria are the most promising mining sites, specifically, those that have high-Ti regoliths. Information on the regional distribution and extent of high-Ti regoliths comes mainly from two sources: direct sampling by various Apollo and Luna missions, and remote sensing by gamma-ray spectroscopy and Earth-based measurements of lunar spectral reflectance. Sampling provides essential control on calibration and interpretation of data from remote sensing. These data indicate that Mare Tranquillitatis is the principal area of high-Ti regolith of the eastern nearside, but large areas of high-Ti regolith are indicated in the Imbrium and Procellarum regions. Recovery of significant amounts of He-3 will require mining billions of tonnes of regolith. Large individual areas suitable for mining must therefore be delineated. The concentration of He in the finer size fractions and considerations of ease of mining mean that mining areas must be as free as possible of sizable craters and blocks of rock. Pending additional lunar missions, information regarding these features must be obtained from lunar photographs, photogeologic maps, and radar surveys. The present study is decidedly preliminary; available information is much to limited to permit even a close approach to final evaluations. As a prelude to recovery of He from the Moon, systematic exploration and sampling of high-Ti regoliths should therefore have a high priority in future lunar missions. Author

N93-17436*# Utah State Univ., Logan. Center for Space Engineering.
THE LUNAR ORBITAL PROSPECTOR
Frank J. Redd, James N. Cantrell, and Greg McCurdy *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 199-207 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

The establishment of lunar bases will not end the need for remote sensing of the lunar surface by orbiting platforms. Human and robotic surface exploration will necessarily be limited to some proximate distance from the support base. Near real-time, high-resolution, global characterization of the lunar surface by orbiting sensing systems will continue to be essential to the understanding of the Moon's geophysical structure and the location of exploitable minerals and deposits of raw materials. The Lunar Orbital Prospector (LOP) is an orbiting sensing platform capable of supporting a variety of modular sensing packages. Serviced by a lunar-based shuttle, the LOP will permit the exchange of instrument packages to meet evolving mission needs. The ability to recover, modify, and rotate sensing packages allows their reuse in varying combinations. Combining this flexibility with robust orbit modification capabilities and near real-time telemetry links provides considerable system responsiveness. Maintenance and modification of the LOP orbit are accomplished through use of an onboard propulsion system that burns lunar-supplied oxygen and aluminum. The relatively low performance of such a system is more than compensated for by the elimination of the need for Earth-supplied propellants. The LOP concept envisions a continuous expansion of capability through the incorporation of new instrument technologies and the addition of platforms. Author

N93-17437*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
LUNAR OBSERVER LASER ALTIMETER OBSERVATIONS FOR LUNAR BASE SITE SELECTION
James B. Garvin and Jack L. Bufton *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 209-217 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

One of the critical datasets for optimal selection of future lunar landing sites is local- to regional-scale topography. Lunar base site selection will require such data for both engineering and scientific operations purposes. The Lunar Geoscience Orbiter or Lunar Observer is the ideal precursory science mission from which to obtain this required information. We suggest that a simple laser altimeter instrument could be employed to measure local-scale slopes, heights, and depths of lunar surface features important to lunar base planning and design. For this reason, we have designed and are currently constructing a breadboard of a Lunar Observer Laser Altimeter (LOLA) instrument capable of acquiring contiguous-footprint topographic profiles with both 30-m and 300-m along-track resolution. This instrument

meets all the severe weight, power, size, and data rate limitations imposed by Observer-class spacecraft. In addition, LOLA would be capable of measuring the within-footprint vertical roughness of the lunar surface, and the 1.06-micron relative surface reflectivity at normal incidence. We have used airborne laser altimeter data for a few representative lunar analog landforms to simulate and analyze LOLA performance in a 100-km lunar orbit. We demonstrate that this system in its highest resolution mode (30-m diameter footprints) would quantify the topography of all but the very smallest lunar landforms. At its global mapping resolution (300-m diameter footprints), LOLA would establish the topographic context for lunar landing site selection by providing the basis for constructing a 1-2 km spatial resolution global, geodetic topographic grid that would contain a high density of observations (e.g., approximately 1000 observations per each 1 deg by 1 deg cell at the lunar equator). The high spatial and vertical resolution measurements made with a LOLA-class instrument on a precursory Lunar Observer would be highly synergistic with high-resolution imaging datasets, and will allow for direct quantification of critical slopes, heights, and depths of features visible in images of potential lunar base sites. Author

N93-17438*# Hawaii Univ., Honolulu. Planetary Geosciences Div.
A SEARCH FOR INTACT LAVA TUBES ON THE MOON: POSSIBLE LUNAR BASE HABITATS
Cassandra R. Coombs and B. Ray Hawke *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 219-229 (For primary document see N93-17414 05-91)
(Grants NAGw-237; NsG-7323)
(PGD-Publ-541; HIG-Contrib-2165) Avail: CASI HC A03/MF A03

We have surveyed lunar sinuous rilles and other volcanic features in an effort to locate intact lava tubes that could be used to house an advanced lunar base. Criteria were established for identifying intact tube segments. Sixty-seven tube candidates within 20 rilles were identified on the lunar nearside. The rilles, located in four mare regions, varied in size and sinuosity. We identified four rilles that exhibited particularly strong evidence for the existence of intact lava tube segments. These are located in the following areas: (1) south of Gruithuisen K, (2) in the Marius Hills region, (3) in the southeastern Mare Serenitatis, and (4) in the eastern Mare Serenitatis. We rated each of the 67 probable tube segments for lunar base suitability based on its dimensions, stability, location, and access to lunar resources. Nine tube segments associated with three separate rilles are considered prime candidates for use as part of an advanced lunar base. Author

N93-17439*# Texas Univ., Austin. Inst. for Geophysics.
A SEISMIC RISK FOR THE LUNAR BASE
Juergen Oberst and Yosio Nakamura *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 231-233 (For primary document see N93-17414 05-91)
(Grant NAGw-1064)
(Contrib-769) Avail: CASI HC A01/MF A03

Shallow moonquakes, which were discovered during observations following the Apollo lunar landing missions, may pose a threat to lunar surface operations. The nature of these moonquakes is similar to that of intraplate earthquakes, which include infrequent but destructive events. Therefore, there is a need for detailed study to assess the possible seismic risk before establishing a lunar base. Author

N93-17440*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
LUNAR ARCHITECTURE AND URBANISM
Brent Sherwood *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 237-241 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

Human civilization and architecture have defined each other for over 5000 years on Earth. Even in the novel environment of space, persistent issues of human urbanism will eclipse, within a historically short time, the technical challenges of space settlement that dominate our current view. By adding modern topics in space engineering, planetology, life support, human factors, material invention, and conservation to their already renaissance array of expertise, urban designers can responsibly apply ancient, proven standards to the exciting new opportunities afforded by space. Inescapable facts about the Moon set real boundaries within which tenable lunar urbanism and its component architecture must eventually develop. Author

N93-17441*# Houston Univ., TX. Sasakawa International Center for Space Architecture.
EARTH-BASED ANALOGS OF LUNAR AND PLANETARY FACILITIES
Larry Bell and Guillermo Trotti *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 243-247 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

Antarctica contains areas where the environment and terrain are more similar to regions on the Moon and Mars than any other place on Earth. These features offer opportunities for simulations to determine performance capabilities of people and machines in harsh, isolated locales. The Sasakawa International Center for Space Architecture (SICSA) plans to create a facility on Antarctica for research, planning, and demonstrations in support of planetary exploration. The Antarctic Planetary Testbed (APT) will be financed and utilized by public and private organizations throughout the world. Established on a continent owned by no country, it can serve as a model for cooperation between spacefaring nations. APT science and technology programs will expand knowledge about the nature and origin of our solar system, and will support preparations for human settlements beyond Earth that may occur within the first quarter of the next century. The initial APT facility, conceived to be operational by the year 1992, will be constructed during the summer months by a crew of approximately 12. Six to eight of these people will remain through the winter. As in space, structures and equipment systems will be modular to facilitate efficient transport to the site, assembly, and evolutionary expansion. State-of-the-art waste recovery/recycling systems are also emphasized due to their importance in space. Author

N93-17442*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
INFLATABLE HABITATION FOR THE LUNAR BASE **c54**
M. Roberts *In its* The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 249-253 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

Inflatable structures have a number of advantages over rigid modules in providing habitation at a lunar base. Some of these advantages are packaging efficiency, convenience of expansion, flexibility, and psychological benefit to the inhabitants. The relatively small, rigid cylinders fitted to the payload compartment of a launch vehicle are not as efficient volumetrically as a collapsible structure that fits into the same space when packaged, but when deployed is much larger. Pressurized volume is a valuable resource. By providing that resource efficiently, in large units, labor intensive external expansion (such as adding additional modules to the existing base) can be minimized. The expansive interior in an inflatable would facilitate rearrangement of the interior to suite the evolving needs of the base. This large, continuous volume would also relieve claustrophobia, enhancing habitability and improving morale. The purpose of this paper is to explore some of the aspects of inflatable habitat design, including structural, architectural, and environmental considerations. As a specific case, the conceptual design of an inflatable lunar habitat, developed for the Lunar Base Systems Study at the Johnson Space Center, is described. Author

N93-17443*# Reynolds (K. H.), McLean, VA.
PRELIMINARY DESIGN STUDY OF LUNAR HOUSING CONFIGURATIONS **c54**
K. H. Reynolds *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 255-259 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

A preliminary design study assesses various configurations for habitation of the lunar surface. The study assumes an initial 4-man habitation module expandable to a 48-man concept. Through the numerous coupling combinations of identical modules, five basic configuration types are identified. A design model presents each configuration in light of certain

issues. The issues include circulation, internal and external spatial characteristics, functional organizations, and future growth potential. The study discusses the attributes, potentials, and unique requirements of each configuration. Author

N93-17444*# Architectural Horizon, Makkah (Saudi Arabia).
PREFABRICATED FOLDABLE LUNAR BASE MODULAR SYSTEMS FOR HABITATS, OFFICES, AND LABORATORIES **c54**
Yousef Hijazi *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 261-266 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

The first habitat and work station on the lunar surface undoubtedly has to be prefabricated, self-erecting, and self-contained. The building structure should be folded and compacted to the minimum size and made of materials of minimum weight. It must also be designed to provide maximum possible habitable and usable space on the Moon. For this purpose the concept of multistory, foldable structures was further developed. The idea is to contain foldable structural units in a cylinder or in a capsule adapted for launching. Upon landing on the lunar surface, the cylinder of the first proposal in this paper will open in two hinge-connected halves while the capsule of the second proposal will expand horizontally and vertically in all directions. In both proposals, the foldable structural units will self-erect providing a multistory building with several room enclosures. The solar radiation protection is maintained through regolith-filled pneumatic structures as in the first proposal, or two regolith-filled expandable capsule shells as in the second one, which provide the shielding while being supported by the erected internal skeletal structure. Author

N93-17445*# Construction Technology Labs., Skokie, IL.
CONCRETE LUNAR BASE INVESTIGATION **c54**
T. D. Lin, Jonathan A. Senseny (Citadel Coll., Charleston, SC.), Larry D. Arp (Citadel Coll., Charleston, SC.), and Charles Lindbergh (Citadel Coll., Charleston, SC.) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 267-274 Previously announced in IAA as A89-34371 Sponsored by NASA. Johnson Space Center, Prestressed Concrete Inst., Chicago Univ., and Lockheed EMSCO (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

This paper presents results of structural analyses and a preliminary design of a precast, prestressed concrete lunar base subjected to 1-atm internal pressure. The proposed infrastructure measures 120 ft in diameter and 72 ft in height, providing 33,000 sq ft of work area for scientific and industrial operations. Three loading conditions were considered in the design (1) during construction, (2) under pressurization, and (3) during an air-leak scenario. A floating foundation, capable of rigid body rotation and translation as the lunar soil beneath it yields, was developed to support the infrastructure and to ensure the airtightness of the system. Results reveal that it is feasible to use precast, prestressed concrete for construction of large lunar bases on the Moon. Author

N93-17446*# Future Systems Consultants, Los Angeles, CA.
VERTICAL REGOLITH SHIELD WALL CONSTRUCTION FOR LUNAR BASE APPLICATIONS **c54**
Jan Kaplicky, David Nixon, and Jane Wernick (Arup, Ove and Partners, Los Angeles, CA) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 275-279 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

Lunar bases located on the lunar surface will require permanent protection from radiation and launch ejecta. This paper outlines a method of providing physical protection using lunar regolith that is constructed in situ as a modular vertical wall using specially devised methods of containment and construction. Deployable compartments, reinforced with corner struts, are elevated and filled by a moving gantry. The compartments interlock to form a stable wall. Different wall heights, thicknesses, and plan configurations are achieved by varying the geometry of the individual compartments, which are made from woven carbon fibers. Conventional terrestrial structural engineering techniques can be modified and used to establish the structural integrity and performance of the wall assembly. Author

N93-17447*# Integrated Space Systems Corp., Collegeville, PA.
EVOLVING CONCEPTS OF LUNAR ARCHITECTURE: THE POTENTIAL OF SUBSELENE DEVELOPMENT **c54**
Andrew W. Daga, Meryl A. Daga, and Wendel R. Wendel (Starnet Structures, Inc., West Babylon, NY.) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 281-291 (For primary document see N93-17414 05-91)
Avail: CASI HC A03/MF A03

In view of the superior environmental and operational conditions that are thought to exist in lava tubes, popular visions of permanent settlements built upon the lunar surface may prove to be entirely romantic. The factors that will ultimately come together to determine the design of a lunar base are complex and interrelated, and they call for a radical architectural solution. Whether lunar surface-deployed superstructures can answer these issues is called into question. One particularly troublesome concern in any lunar base design is the need for vast amounts of space, and the ability of man-made structures to provide such volumes in a reliable pressurized habitat is doubtful. An examination of several key environmental design issues suggests that the alternative mode of subselene development may offer the best opportunity for an enduring and humane settlement. Author

N93-17448*# Design Science, Los Angeles, CA.
LUNAR SUBSURFACE ARCHITECTURE ENHANCED BY ARTIFICIAL BIOSPHERE CONCEPTS **c54**
Jason D. Klassi, Carlos J. Rocha, and Charles A. Carr *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 293-298 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

The integration of artificial biosphere technology with subselene architecture can create a life-enhancing, productive habitat that is safe from solar radiation and extreme temperature fluctuations while maximizing resources brought from Earth and derived from lunar regolith. In the short term, the resulting biotectural (biosphere and architectural) designs will not only make the structures more habitable, productive, and manageable, but will ultimately provide the self-sufficiency factors necessary for the mature lunar settlement. From a long-term perspective, this biotecture approach to astronautics and extraterrestrial development (1) helps reduce mass lift requirements, (2) contributes to habitat self-sufficiency, and (3) actualizes at least one philosophy of solar system exploration, which is to exploit nonterrestrial resources in an effort to conserve our natural resources on this planet. Author

N93-17449*# BRW, Inc., Minneapolis, MN.
EXTRATERRESTRIAL APPLICATIONS OF SOLAR OPTICS FOR INTERIOR ILLUMINATION **c74**
David A. Eijadi and Kyle D. Williams *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 299-303 Previously announced in IAA as A89-45749 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

Solar optics is a terrestrial technology that has potential extraterrestrial applications. Active solar optics (ASO) and passive solar optics (PSO) are two approaches to the transmission of sunlight to remote interior spaces. Active solar optics is most appropriate for task illumination, while PSO is most appropriate for general illumination. Research into solar optics, motivated by energy conservation, has produced lightweight and low-cost materials, products that have applications to NASA's Controlled Ecological Life Support System (CELSS) program and its lunar base studies. Specifically, prism light guides have great potential in these contexts. Several applications of solar optics to lunar base concepts are illustrated. Author

N93-17450*# Geological Survey, Flagstaff, AZ. Branch of Astrogeology.
THE ROLES OF HUMANS AND ROBOTS AS FIELD GEOLOGISTS ON THE MOON
Paul D. Spudis and G. Jeffrey Taylor (New Mexico Univ., Albuquerque.) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 307-313 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

The geologic exploration of the Moon will be one of the primary

scientific functions of any lunar base program. Geologic reconnaissance, the broad-scale characterization of processes and regions, is an ongoing effort that has already started and will continue after base establishment. Such reconnaissance is best done by remote sensing from lunar orbit and simple, automated, sample return missions of the Soviet Luna class. Field study, in contrast, requires intensive work capabilities and the guiding influence of human intelligence. We suggest that the most effective way to accomplish the goals of geologic field study on the Moon is through the use of teleoperated robots, under the direct control of a human geologists who remains at the lunar base, or possibly on Earth. These robots would have a global traverse range, could possess sensory abilities optimized for geologic field work, and would accomplish surface exploration goals without the safety and life support concerns attendance with the use of human geologists on the Moon. By developing the capability to explore any point on the Moon immediately after base establishment, the use of such teleoperated, robotic field geologists makes the single-site lunar base into a 'global' base from the viewpoint of geologic exploration. Author

N93-17451*# New Mexico State Univ., Las Cruces. Dept. of Astronomy
SOME ASTRONOMICAL CHALLENGES FOR THE TWENTY-FIRST CENTURY **c89**
Jack O. Burns *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 315-319 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

This paper addresses some of the scientific puzzles that astronomers may face in the next century. Four areas in astronomy are discussed in detail. These include cosmology and galaxy formation, active galaxies and quasars, supernovae and stellar remnants, and the formation of stars and planets. A variety of observatories on the Moon are proposed to attack these astronomical challenges. Author

N93-17452*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RADIO ASTROMETRY FROM THE MOON **c89**
R. P. Linfield *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 321-322 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

An array of three radio telescopes on the Moon, separated by 100-1000 km, could measure the positions of compact radio sources 50-100 times more accurately than can be done on Earth. These measurements would form an all-sky reference frame of extreme precision (5-10 micro-arcsec) and stability, with applications to the dynamics of the solar system, our galaxy, and nearby galaxies. Author

N93-17453*# BDM International, Inc., Albuquerque, NM.
REQUIRED TECHNOLOGIES FOR LUNAR ASTRONOMICAL OBSERVATORIES **c89**
Stewart W. Johnson and John P. Wetzel *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 323-328 (For primary document see N93-17414 05-91)
(Grant NAG9-245)
Avail: CASI HC A02/MF A03

Each of the major new observatories proposed to take advantage of the characteristics of the lunar environment requires appropriate advances in technology. These technologies are in the areas of contamination/interference control, test and evaluation, manufacturing, construction, autonomous operations and maintenance, power and heating/cooling, stable precision structures, optics, parabolic antennas, and communications/control. Telescopes for the lunar surface need to be engineered to operate for long periods with minimal intervention by humans or robots. What is essential for lunar observatory operation is enforcement of a systems engineering approach that makes compatible all lunar operations associated with habitation, resource development, and science. Author

N93-17454*# BDM International, Inc., Albuquerque, NM.
ENVIRONMENTAL EFFECTS ON LUNAR ASTRONOMICAL OBSERVATORIES **c89**
Stewart W. Johnson, G. Jeffrey Taylor (Hawaii Univ., Manoa.), and John P. Wetzel *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 329-335 (For primary document see N93-17414 05-91)
(Grant NAG9-245)
Avail: CASI HC A02/MF A03

The Moon offers a stable platform with excellent seeing conditions for astronomical observations. Some troublesome aspects of the lunar environment will need to be overcome to realize the full potential of the Moon as an observatory site. Mitigation of negative effects of vacuum, thermal radiation, dust, and micrometeorite impact is feasible with careful engineering and operational planning. Shields against impact, dust, and solar radiation need to be developed. Means of restoring degraded surfaces are probably essential for optical and thermal control surfaces deployed in long-lifetime lunar facilities. Precursor missions should be planned to validate and enhance the understanding of the lunar environment (e.g., dust behavior without and with human presence) and to determine environmental effects on surfaces and components. Precursor missions should generate data useful in establishing keepout zones around observatory facilities where rocket launches and landings, mining, and vehicular traffic could be detrimental to observatory operation. Author

N93-17455*# Lockheed Missiles and Space Co., Palo Alto, CA. Space Sciences Lab.
LUNAR BASE ACTIVITIES AND THE LUNAR ENVIRONMENT
Richard R. Vondrak *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 337-345 (For primary document see N93-17414 05-91)
Avail: CASI HC A02/MF A03

The Moon is an attractive site for astronomical observatories and other facilities because of the absence of a substantial lunar atmosphere and the stability of the lunar surface. The present lunar atmosphere is sufficiently transparent that there is no significant image distortion due to absorption or refraction. This thin atmosphere results from a combination of small sources and prompt losses. The major source that has been identified is the solar wind, whose total mass input into the lunar atmosphere is approximately 50 gm/sec. The major components of the solar wind are light elements (H and He) that promptly escape from the lunar surface by exospheric evaporation (Jeans' escape). The principal atmospheric loss mechanism for heavier gases is photoionization within a period of weeks to months, followed by immediate loss to the solar wind. Lunar base activities will modify the lunar atmosphere if gas is released at a larger rate than that now occurring naturally. Possible gas sources are rocket exhaust, processing of lunar materials, venting of pressurized volumes, and astronaut life support systems. For even modest lunar base activity, such sources will substantially exceed natural sources, although effects are expected to be localized and transient. The Apollo database serves as a useful reference for both measurements of the natural lunar environment and its modification by lunar base activities. Author

N93-17456*# New Mexico State Univ., Las Cruces. Dept. of Astronomy.
AN ARTIFICIALLY GENERATED ATMOSPHERE NEAR A LUNAR BASE
Jack O. Burns, Ilias Fernini (New Mexico Univ., Albuquerque.), Martin Sulkanen (New Mexico Univ., Albuquerque.), Nebojsa Duric (New Mexico Univ., Albuquerque.), G. Jeffrey Taylor (New Mexico Univ., Albuquerque.), and Stewart W. Johnson (BDM International, Inc., Albuquerque, NM.) *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 347-350 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

We discuss the formation of an artificial atmosphere generated by vigorous lunar base activity in this paper. We developed an analytical, steady-state model for a lunar atmosphere based upon previous investigations of the Moon's atmosphere from Apollo. Constant gas-injection rates, ballistic trajectories, and a Maxwellian particle distribution for an oxygen-like gas are assumed. Even for the extreme case of continuous He-3 mining of the lunar regolith, we find that the lunar atmosphere would not significantly degrade astronomical observations beyond about 10 km from the mining operation. Author

N93-17457*# Missouri Univ., Columbia.
A MANNED EXOBIOLOGY LABORATORY BASED ON THE MOON **c14**

Charles W. Gehrke, Cyril Ponnamperuma (Maryland Univ., College Park.), Kenneth C. Kuo, John E. McEntire (Cancer Research Center, Columbia, MO.), David L. Stalling (Interior Dept., Columbia, MO.), and Robert W. Zumwalt *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 351-352 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

Establishment of an exobiology laboratory on the Moon would provide a unique opportunity for exploration of extraterrestrial materials on a long-term, ongoing basis, for elucidation of exobiological processes and chemical evolution. A major function of the lunar exobiology laboratory would be to examine samples collected from other planets (e.g., Mars) for the presence of extant or extinct life. By establishing a laboratory on the Moon, preliminary analyses could be conducted away from Earth, thus establishing that extraterrestrial materials are benign before their return to Earth for more extensive investigations. The Moon-based exobiology laboratory would have three major components for study of samples returned from other planets: (1) the search for extant life - this component would focus on the detection and identification of life forms using biological, physical, and chemical methods; (2) the search for extinct life - this component would concentrate on identification of extinct life using micropaleontological physical and chemical means; and (3) the search and evidence of chemical evolution - this component would be devoted to the detection and identification of molecules revealing prebiotic chemical evolution. Author

N93-17458*# American Inst. of Biological Sciences, Washington, DC.
POSSIBLE BIOMEDICAL APPLICATIONS AND LIMITATIONS OF A VARIABLE-FORCE CENTRIFUGE ON THE LUNAR SURFACE: A RESEARCH TOOL AND AN ENABLING RESOURCE **c51**
Keith L. Cowing *In* NASA. Johnson Space Center, The Second Conference on Lunar Bases and Space Activities of the 21st Century, Volume 1 Sep. 1992 p 353-357 (For primary document see N93-17414 05-91)
Avail: CASI HC A01/MF A03

Centrifuges will continue to serve as a valuable research tool in gaining an understanding of the biological significance of the inertial acceleration due to gravity. Space- and possibly lunar-based centrifuges will play a significant and enabling role with regard to the human component of future lunar and martian exploration, both as a means of accessing potential health and performance risks and as a means of alleviating these risks. Lunar-based centrifuges could be particularly useful as part of a program of physiologic countermeasures designed to alleviate the physical deconditioning that may result from prolonged exposure to a 1/6-g environment. Centrifuges on the lunar surface could also be used as part of a high-fidelity simulation of a trip to Mars. Other uses could include crew readaptation to 1 g, waste separation, materials processing, optical mirror production in situ on the Moon, and laboratory specimen separation. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

N93-16944*# Alabama Univ., Huntsville. Dept. of Physics.
THE FNAS GAMMA RAY OBSERVATORY Final Report
A. Gordon Emslie 8 Jan. 1993 18 p
(Contract NAS8-38609)
(NASA-CR-191418; NAS 1.26:191418) Avail: CASI HC A03/MF A01

Highly stressed and nonpotential magnetic fields in solar active region are believed to be the site and source of M or X class flares which release as much as 10(exp 32) ergs in a periods of 10 to 1000 s with intense emission detected over most of the electromagnetic spectrum. Such M or X class flares are the most likely gamma-ray emission candidates since sheared magnetic field is the means of energy storage for flare events. We have studied the correlation between 'nonpotentiality' parameters such as 'shear angle' and maximum magnetic field strength with the occurrences gamma-ray events. Also the angle of deviation of the magnetic field from the line of sight was studied since the bremsstrahlung gamma-ray beam produced by relativistic ions and electrons is highly directional in the forward direction and required non-vertical field-lines for the detection of the disk-center events. Author

N93-17174# Midwest Research Inst., Golden, CO.
A COMPARISON OF DATA FROM SOLMET/ERSATZ AND THE NATIONAL SOLAR RADIATION DATA BASE
W. Marion and D. Myers Nov. 1992 34 p
(Contract DE-AC02-83CH-10093)
(DE93-000018; NREL/TP-463-5118) Avail: CASI HC A03/MF A01

This report compares data from the new National Solar Radiation Data Base (NSRDB) with data from the earlier SOLMET/ERSATZ data base. It compares the two data bases, station-by-station, with respect to their long-term average daily values of global horizontal and direct normal solar radiation. We conclude that on an annual basis, NSRDB values for global horizontal radiation are within plus/minus 5 percent of SOLMET/ERSATZ values for 60 percent of the stations, more than 5 percent greater than the SOLMET/ERSATZ values for 30 percent of the stations, and more than 5 percent less than the SOLMET/ERSATZ values for 10 percent of the stations. On an annual basis for direct nominal radiation, the NSRDB values are with plus/minus 5 percent of the SOLMET/ERSATZ data for only 40 percent of the stations, more than 5 percent greater than the SOLMET/ERSATZ values for 45 percent of the stations, and more than 5 percent less than the SOLMET/ERSATZ values for 15 percent of the stations. In general, the NSRDB shows higher values of solar radiation for the eastern United States, particularly the Northeast, and lower values for some of the western states (Arizona, Colorado, Idaho, Nevada, New Mexico, Utah, and Wyoming). However, because some of the stations within a state show higher values of solar radiation while others show lower values, this generalization may be misleading when concerned with a particular station. Consequently, the appendices provide tables showing a station-by-station comparison of the NSRDB and SOLMET/ERSATZ data. In addition to comparing annual values, the tables compare the two data bases for the months of August and December. This comparison shows larger differences between the two data bases for December. DOE

N93-17631# Rome Univ. (Italy). Dipartimento di Fisica.
LONG-TERM VARIATIONS IN THE GEOMAGNETIC ACTIVITY LEVEL. 1: A CONNECTION WITH SOLAR-WIND SOURCES
O. BorelloFilisetti (Politecnico di Torino, Italy), V. Mussino (Politecnico di Torino, Italy), M. Parisi, and M. Storini (Consiglio Nazionale delle Ricerche, Rome, Italy) 11 Apr. 1991 36 p Sponsored in part by Italian Ministry of University Research and Scientific Research and CNR
(Nota-Interna-978; ETN-92-92606) Avail: CASI HC A03/MF A01

The long term features in solar-terrestrial relations from 1868 to 1988 were studied by means of correlative analyses between monthly values of the aa index and Rz numbers. The role of each type of solar wind sources is underlined in connection with the different sunspot cycle phases. It is suggested that in general the solar transient activity dominates the ascending phases, while coronal hole features dominate the descending ones. The geomagnetic response to transient and corotating interplanetary disturbances seems to be the origin of such behavior, provided that the considered aa set be used as proxy data for solar wind features in the near Earth environment. An interplay between sunspot heliographic positions and polar coronal hole extensions towards the equator exists, as it comes out from the analysis of the sunspot cycle N.19. ESA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N93-17067# Los Alamos National Lab., NM.
MEASUREMENTS AND CALCULATIONS OF THE CHARACTERISTICS FOR A SPACE-BASED NEUTRON SENSOR
A. Garnett, ed. Oct. 1992 28 p
(Contract W-7405-eng-36)
(DE93-001429; LA-12340-MS) Avail: CASI (US Sales Only)

Preliminary estimates of the impact of changes in the mission for

space-based verification sensors can be obtained by using computer simulations. This paper describes calculations and measurements to evaluate the performance of representative designs for neutron sensors. The calculations use programs recently developed at Los Alamos National Laboratory to combine physics models for the production of neutrons at high energies with conventional codes for neutron transport at lower energies. Included are discussions of the physics assumptions, comparisons between calculations and laboratory calibrations, energy-dependent detector response functions, investigations of spacecraft background, and several studies of alternative sensor designs. The results provide a basis for future evaluations of detailed proposals for possible sensors. DOE

N93-17182# Superconducting Super Collider Lab., Dallas, TX.
COSMIC RAY TEST OF SDC PROTOTYPE MUON DRIFT TUBES
T. Fukui, H. J. Lubatti (Washington Univ., Seattle.), J. Thunborg, C. Daly (Washington Univ., Seattle.), R. Davisson (Washington Univ., Seattle.), W. Davisson (Washington Univ., Seattle.), W. Dougherty (Washington Univ., Seattle.), H. Guldenmann (Washington Univ., Seattle.), J. Hersch (Washington Univ., Seattle.), and K. Paulson (Washington Univ., Seattle.) et al Jun. 1992 6 p Presented at the International Conference on Advanced Technology and Particle Physics, Como, Italy, 22-26 Jun. 1992
(Contract DE-AC35-89ER-40486)
(DE93-001680; SSCL-Preprint-155; CONF-9206222-3) Avail: CASI HC A02/MF A01

Preliminary results are presented from cosmic ray tests of the SDC muon detector prototype module. The module consists of 30 drift cells. Each drift cell is a 9 m long, 73 mm inner diameter aluminum tube with simple field shaping electrodes. The anode wire is gold plated tungsten. The construction of the module makes use of the drift tubes as structural elements. The resolution and efficiency are approximately 200 microns and 99 percent, respectively. DOE

N93-17379# California Univ., Berkeley. Lawrence Berkeley Lab.
MEASUREMENTS OF THE COSMIC MICROWAVE BACKGROUND TEMPERATURE AT 1.47 GHz Ph.D. Thesis
M. J. Bensadoun Nov. 1991 135 p
(Contract DE-AC03-76SF-00098)
(DE93-000587; LBL-32436) Avail: CASI HC A07/MF A02

A radiofrequency-gain total power radiometer measured the intensity of the cosmic microwave background (CMB) at a frequency of 1.47 GHz (20.4 cm wavelength) from White Mountain, California, in September 1988 and from the South Pole, Antarctica, in December 1989. The CMB thermodynamic temperature, TCMB, is 2.27 +/- 0.25 K (68 percent C.L.) measured from White Mountain and 2.26 +/- 0.21 K from the South Pole site. The combined result is 2.27 +/- 0.19 K. The correction for galactic emission has been derived from scaled low-frequency maps and constitutes the main source of error. The atmospheric signal is found by extrapolation from zenith scan measurements at higher frequencies. The result is consistent with previous low-frequency measurements, including a measurement at 1.41 GHz (Levin et al. 1988) made with an earlier version of this instrument. The result is approximately 2.5 sigma (approximately 1 percent probability) from the 2.74 +/- 0.02 K global average CMB temperature. DOE

N93-17383# Los Alamos National Lab., NM.
MILAGRO: A LOW ENERGY THRESHOLD EXTENSIVE AIR SHOWER ARRAY
G. Sinnis 1992 13 p Presented at the Towards a Major Atmospheric Cherenkov Detector for TeV Astro/Particle Physics, Palaiseau (France), 11-12 Jun. 1992
(Contract W-7405-eng-36)
(DE93-000852; LA-UR-92-3132; CONF-9206293-1) Avail: CASI HC A03/MF A01

Milagro is a proposed extensive air shower (EAS) array with a large water Cerenkov detector at its center. It will have a low energy threshold, approximately 500 GeV, and good angular resolution, approximately 0.4 degrees. With the large aperture and duty factor of an EAS array, and the energy threshold of an atmospheric Cerenkov telescope, it will be ideally poised to discover new, steady sources of very high energy gamma radiation similar to the Crab nebula, and transient phenomena analogous to the gamma ray bursts seen at lower energies. Here we describe the Milagro detector and give results of tests performed at the CYGNUS array that demonstrate the capabilities of the water Cerenkov technique in detecting and reconstructing extensive air showers. DOE

N93-17466# Sandia National Labs., Albuquerque, NM.
IMPROVED RESPONSE FUNCTIONS FOR GAMMA-RAY SKYSHINE ANALYSES
J. K. Shultis, R. E. Faw, and X. Deng (Kansas State Univ., Manhattan.) Sep. 1992 113 p
(Contract DE-AC04-76DP-00789)
(DE93-003230; SAND-92-7296) Avail: CASI HC A06/MF A02

A computationally simple method, based on line-beam response functions, is refined for estimating gamma skyshine dose rates. Critical to this method is the availability of an accurate approximation for the line-beam response function (LBRF). In this study, the LBRF is evaluated accurately with the point-kernel technique using recent photon interaction data. Various approximations to the LBRF are considered, and a three parameter formula is selected as the most practical approximation. By fitting the approximating formula to point-kernel results, a set of parameters is obtained that allows the LBRF to be quickly and accurately evaluated for energies between 0.01 and 15 MeV, for source-to-detector distances from 1 to 3000 m, and for beam angles from 0 to 180 degrees. This re-evaluation of the approximate LBRF gives better accuracy, especially at low energies, over a greater source-to-detector range than do previous LBRF approximations. A conical beam response function is also introduced for application to skyshine sources that are azimuthally symmetric about a vertical axis. The new response functions are then applied to three simple skyshine geometries (an open silo geometry, an infinite wall, and a rectangular four-wall building) and the results are compared to previous calculations and benchmark data. DOE

N93-17596# Rome Univ. (Italy). Dipartimento di Fisica.
ON THE BIOLOGICAL EFFECTS OF COSMIC RAYS: EPIDEMIOLOGICAL STUDY [SUGLI EFFETTI BIOLOGICI DEI RAGGI COSMICI: STUDI EPIDEMIOLOGICI]
A. M. Conforto and C. Signorini (Consiglio Nazionale delle Ricerche, Rome, Italy) 11 Apr. 1991 11 p In ITALIAN Presented at 5th Convegno Nazionale di Fisica Cosmica, Pisa, Italy, 27-30 Nov. 1990
(Nota-Interna-979; ETN-92-92607) Avail: CASI HC A03/MF A01

The determination of the biological effects of cosmic rays and other natural radiation to resolve the more general problem of the consequences on human health, from the basis of ionizing radiation, is addressed. Difficulties relating to an epmidemiological study are outlined and results are discussed particularly concerning their inconsistency. In particular, high and low doses are discussed, referencing the Hiroshima bomb, the HBRA (High Background Radiation Area), and the CA (Control Area). High and low regions are discussed for the case of cancer. ESA

N93-17627# Rome Univ. (Italy). Dipartimento di Fisica.
COSMIC RAY NM-64 NEUTRON MONITOR DATA-18
N. Iucci, F. Re (Consiglio Nazionale delle Ricerche, Rome, Italy), F. Signoretti (Consiglio Nazionale delle Ricerche, Rome, Italy), C. Signorini (Consiglio Nazionale delle Ricerche, Rome, Italy), G. Villoresi (Consiglio Nazionale delle Ricerche, Rome, Italy), and N. L. Zangrilli (Consiglio Nazionale delle Ricerche, Rome, Italy) 26 Feb. 1991 68 p
(Nota-Interna-972; ETN-92-92600) Avail: CASI HC A04/MF A01

Pressure corrected data from the Rome (Italy) neutron monitor and barometric pressure data are given in tabular form for the year 1989, together with the graphs of the corrected intensity. The atmospheric pressure was measured by two digital barometers: one based on a high resolution force balance pressure transducer; the other based on a high accuracy capacitance sensor. The five minute rates of the monitor sections are recorded with the barometric value. The stability of the monitor is controlled by means of the section ratios. Periodical checks of the electronic equipment and multichannel tests of the counters are made. The pulse height distributions of the amplifier output pulses together with the discriminator input-output coincidence pulses, allow us to follow the stability of the gas pressure in the counter, high and low voltage power supplies, amplifier, and discriminator. ESA

N93-17647# Rome Univ. (Italy). Dipartimento di Fisica.
NORTH-SOUTH ANISOTROPY DURING THE QUASI-STATIONARY MODULATION OF GALACTIC COSMIC RAYS

M. Storini (Consiglio Nazionale delle Ricerche, Rome, Italy), N. Iucci, and S. Pase 18 Mar. 1991 28 p Sponsored in part by Italian Space Agency
(Nota-Interna-975; ETN-92-92603) Avail: CASI HC A03/MF A01

High speed solar wind streams coming from coronal holes produce, in the interplanetary space, a quasi stationary modulation of galactic cosmic rays. This modulation was analyzed taking into account the charged particle isotropic intensity and the north-south anisotropy, derived from ground based measurements. The obtained results for the period Oct. 1964 to Dec. 1987 are summarized. Data from Bartels solar rotation n. 2034 (23 May to 18 Jun. 1982) are used to illustrate the north-south anisotropy phenomenology. The data analysis lead to the conclusion that the average north-south anisotropy behavior observed is related to the corresponding temporal variations detected and/or inferred in the interplanetary magnetic field and the solar wind bulk speed parameters. ESA

N93-17648# Rome Univ. (Italy). Dipartimento di Fisica.
THE SVIRCO STATION: MEASUREMENT AND STUDY OF THE INTENSITY OF COSMIC RAYS IN ROME (ITALY) FROM 1954 [LA STAZIONE SVIRCO: DAL 1954 SI MISURA E SI STUDIA A ROMA L'INTENSITA DEI RAGGI COSMICI]
F. Bachelet and M. Storini (Consiglio Nazionale delle Ricerche, Rome, Italy) 21 Mar. 1991 84 p In ITALIAN
(Nota-Interna-977; ETN-92-92605) Avail: CASI HC A05/MF A01

Secondary component cosmic radiation measurements and their interpretations are addressed. The instruments, personnel, and finance, over the years, are discussed. Research services and results of studies such as atmospheric effects on total ionization, phenomenological study of each primary variation and of their correlations with solar and geophysical effects, spectral modulation of galactic cosmic rays, anisotropy of cosmic rays, and the Sun-Earth relationship and three dimensional modulation phenomena, are described. Foreign guest research and international conference participation are outlined. ESA

N93-17105# Kyoto Univ. (Japan). Dept. of Physics.
GINGA RESULTS OF TYPE 2 AGN'S AND THEIR CONTRIBUTIONS TO THE COSMIC X RAY BACKGROUND
Katsuji Koyama *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 74-80 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A02/MF A04

N93-17112# Hebrew Univ. of Jerusalem, Rehovot (Israel).
EVOLUTIONARY HYBRID ACCRETION DISC MODELS OF AGN AND THE ROSAT COSMIC X RAY BACKGROUND
Amri Wandel (Weizmann Inst. of Science, Rehovoth, Israel) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 123-129 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A02/MF A04

N93-17139# Osservatorio Astrofisico di Arcetri, Florence (Italy).
HI IN GALAXY OUTSKIRTS AND THE EXTRAGALACTIC IONIZING FLUX
Edvige Corbelli and Edwin E. Salpeter (Cornell Univ., Ithaca, NY.) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 271-274 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A01/MF A04

N93-17143# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
ENERGY SPECTRUM OF THE COSMIC X RAY BACKGROUND: SOME CONSIDERATIONS BASED ON THE GINGA RESULTS
Y. Tanaka *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 303-314 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A03/MF A04

N93-17144*# Columbia Univ., New York, NY. Astrophysics Lab.
WHERE HAVE ALL THE SOURCES GONE?
D. J. Helfand and T. T. Hamilton *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 314-320 (For primary document see N93-17094 05-90)
(Grants NAGw-2057; NAG8-183)
Copyright Avail: CASI HC A02/MF A04

N93-17146# Institute of Physical and Chemical Research, Saitama (Japan).
ORIGIN OF THE COSMIC X RAY BACKGROUND RADIATION
Nobuo Terasawa *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 332-337 Sponsored in part by Inoue Foundation for Science (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A02/MF A04

N93-17147# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
ON THE SUITABILITY OF STARBURST GALAXIES AS A CONTRIBUTOR TO THE CXRB
E. J. A. Meurs and T. Boller (Academy of Sciences, Potsdam, German D.R.) *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 338-340 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A02/MF A04

N93-17148# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
CONTRIBUTION OF CLUSTERS OF GALAXIES TO THE XRB
Marguerite Pierre *In its* X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 341-344 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A01/MF A04

N93-17149# Universidad de Santander (Spain). Departimento de Fisica Moderna.
ON THE ORIGIN OF THE X RAY BACKGROUND
X. Barcons *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 345-357 Sponsored in part by DGICYT (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A03/MF A04

N93-17150# Universidad de Santander (Spain). Departimento de Fisica Moderna.
CLUSTERING PROPERTIES OF X RAY SOURCES FROM THE ANALYSIS OF THE GINGA P(D) DISTRIBUTION
L. Toffolatti (Osservatorio Astronomico, Padova, Italy) and X. Barcons *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 358-361 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A01/MF A04

N93-17152# Leicester Univ. (England). X Ray Astronomy Group.
THE ROSAT AUTOCORRELATION FUNCTION OF THE X RAY BACKGROUND
I. Georgantopoulos, G. Stewart, R. Griffiths (Space Telescope Science Inst., Baltimore, MD.), T. Shanks (Durham Univ., England), and B. Boyle (Cambridge Univ., England) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 368-372 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A01/MF A04

N93-17153*# Seattle Univ., WA. Dept. of Astronomy.
QSO'S TO B LESS THAN 22 AND THE COSMIC X RAY BACKGROUND RADIATION: A FLUCTUATIONS CORRELATION APPROACH
S. F. Anderson and X. Wu *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 373-376 (For primary document see N93-17094 05-90)
(Grants NAG5-1254; NAG8-590; NAG5-1253)
Copyright Avail: CASI HC A01/MF A04

N93-17160# Bologna Univ. (Italy). Ist. di Radioastronomia.
AGN AND THE X RAY BACKGROUND: CONCLUDING REMARKS
G. Setti (European Southern Observatory, Garching, Germany) *In* MPI fuer Extraterrestrische Physik, X Ray Emission from Active Galactic Nuclei and the Cosmic X Ray Background Mar. 1992 p 414-420 (For primary document see N93-17094 05-90)
Copyright Avail: CASI HC A02/MF A04

N93-17308*# Mississippi State Univ., Mississippi State. Dept. of Physics and Astronomy.
STRUCTURE IN GAMMA RAY BURST TIME PROFILES: STATISTICAL ANALYSIS 1
John Patrick Lestrade *In* Alabama Univ., 1992 NASA/ASEE Summer Faculty Fellowship Program Dec. 1992 5 p (For primary document see N93-17279 05-80)
Avail: CASI HC A01/MF A03

99 GENERAL

N93-15964# Office of Naval Research European Office, FPO New York, NY.
EUROPEAN SCIENCE NOTES INFORMATION BULLETIN: REPORTS ON CURRENT EUROPEAN AND MIDDLE EASTERN SCIENCE
1992 84 p
(AD-A257228; ONREUR-ESNIB-92-04) Avail: CASI HC A05/MF A01
European Science Notes Information Bulletin describes research being conducted and ideas being developed in Europe and the Middle East as reported by scientists assigned to the Office of Naval Research European Office and guest authors. It is published 6-8 times per year, on an irregular basis. GRA

N93-16113# Phillips Lab., Kirtland AFB, NM.
PATENT WRITE-UPS: PATENTS AVAILABLE FOR LICENSING Interim Report
Yolanda B. Allen 26 Jun. 1992 34 p
(AF Proj. 9991; AF Proj. 6106)
(AD-A256694; AD-E201163; PL-TR-92-2166; SR-271) Avail: CASI HC A03/MF A01
These patent write-ups were put together as a Phillips Laboratory technology transfer initiative. The write-ups are one page explanations of all the Phillips Laboratory, Geophysics Directorate, patents and patent pending inventions. Each write-up describes what the invention is, explains the background of the technology behind the invention, and lists the special features and performance characteristics of the invention. The hope for these write-ups is that they will get the word out about the patents that are available for licensing from the Geophysics Directorate of Phillips Laboratory. GRA

N93-16464# Manchester Univ. (England). Aeronautical Engineering Group.
LANCHESTER: THE MAN
J. A. D. Ackroyd 1991 67 p Presented at the Lanchester Lecture for Royal Aeronautical Society Coventry Branch, England, 18 Sep. 1991
(Aero-Rept-9111; ETN-92-92776) Avail: CASI HC A04/MF A01
A lecture given at the Royal Aeronautical Society to celebrate the memory of Frederick William Lanchester is presented. A biographical sketch is given, and Lanchester's work on the following is discussed: motorcar engineering, aerodynamics, boundary layer theory, lift and drag wing theory. In the appendix the following are addressed: the vortex theory of lift, the vortex, the sine alpha incidence relation. ESA

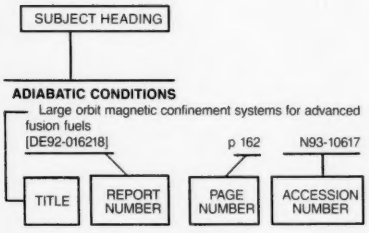
N93-16652*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
1991 RESEARCH AND TECHNOLOGY Technical Memorandum, Fiscal Year 1991
Oct. 1992 349 p LIMITED REPRODUCIBILITY: More than 20% of this document may be affected by color photographs Original contains color illustrations
(NASA-TM-103924; A-92063; NAS 1.15:103924) Avail: CASI HC A15/MF A03; 30 functional color pages
Selected research and technology activities at Ames Research Center, including the Moffett Field site and the Dryden Flight Research Facility, are summarized. These activities exemplify the Center's varied and productive research efforts for 1991. Author

N93-16749# Indian Inst. of Geomagnetism, Bombay. Dept. of Science and Technology.
ANNUAL REPORT, 1990 - 1991
1991 41 p
Avail: CASI HC A03/MF A01
The annual report describes in detail all the scientific activities of the Institute as well as some other events. Research work carried out by the Scientists of the Institute have been reported in 30 papers published or accepted for publication during 1990-91 in Indian and International journals. Institute's scientists also contributed 19 papers in National and International Symposia/Seminars/Workshops. Author

N93-16948# National Science Foundation, Washington, DC.
NATIONAL SCIENCE FOUNDATION ANNUAL REPORT, 1991
1991 62 p Original contains color illustrations
(NSF-92-1) Avail: CASI HC A04/MF A01
This annual report is both a retrospective look at the past year and an opportunity to reflect upon the future. The chapters covered include a directors overview, research reports, education and outreach, international news, instrumentation and facilities, and awards and organizational news. Author

N93-17760# Illinois Univ., Urbana. Materials Research Lab.
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN, MATERIALS RESEARCH LABORATORY PROGRESS REPORT, FY 1992
Jul. 1992 189 p
(Contract DE-FG02-91ER-45439)
(DE93-002655; DOE/ER-45439/132) Avail: CASI HC A09/MF A02
This interdisciplinary laboratory in the College of Engineering supports research in areas of condensed matter physics, solid state chemistry, and materials science. These research programs are developed with the assistance of faculty, students, and research associates in the departments of Physics, Materials Science and Engineering, Chemistry, Chemical Engineering, Electrical Engineering, Mechanical Engineering, and Nuclear Engineering. DOE

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The page number helps you locate the the citation in the abstract section. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus*.

A

ABERRATION
Polarization analysis of a balloon-borne solar magnetograph
[NASA-CR-191270] p 1167 N93-16458

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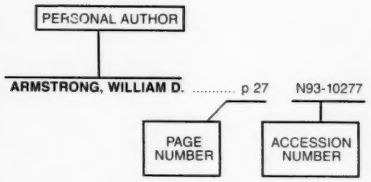

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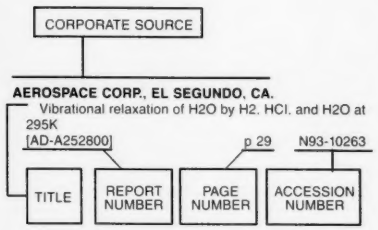

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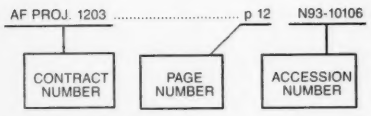

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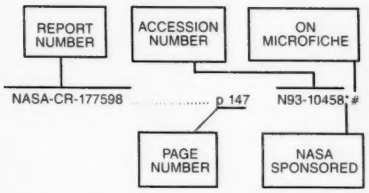

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DOE/ER-75650/1 ..... p 1331 N93-16521 #

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